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NUMBER 1

CELLULAR STUDIES ON THE THYROID GLAND

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STUDIES presented in this paper give evidence of the existence of cells in the thyroid gland of the dog which differ very distinctly from the common cell type found in this gland. Generally the cells appear as small but definite aggregates of several cells among the numerous interfollicular cells but they also occur in connection with the follicles themselves sometimes lying just outside or actually forming a part of their wall or even located within the follicular lumen and embedded in colloid. These different locations are illustrated in Figures 3 and 10a.

The review of the literature disclosed that in 1889 Langendorff described cells in the thyroid gland which differed considerably from the chief cells and called them colloid cells (Kolloidzellen). Since then these cells have been mentioned by very few authors and have hardly been referred to either in the literature or in the textbooks. In the newly published textbook of histology by Maximow and Bloom passing reference is made to cells which seem to be identical with those described in this paper.

This ignored type of cell is distinguished from the common cells of the thyroid in many respects, the cell bodies are larger and in section, appear triangular, multangular, or irregular (Fig. 7a, 8) showing marked variations between these forms. When arranged in small groups they flatten each other on adjacent surfaces, hence giving rise to various shapes.

The cytoplasm is uniform in appearance. The affinity of this cytoplasm of the majority of these cells to acid stains is shown by its bright red reaction seen in eosin-hematoxylin preparations, but there are a few of the cells which reveal an attraction for hematoxylin. Their nuclei are spherical sometimes slightly ellipsoidal but always are very large relatively and generally are eccentric in position. The chromatic meshwork of most of them is well differentiated and is conspicuous because of its dark staining and the lightness of the remaining nuclear substance. Few of the nuclei do not show this contrast because of their even and intensive coloration with hematoxylin (Figs. 4, 5, 6). Hence this distinction places the large thyroid cells in two groups, those with a well defined chromatin network and those with dense nuclei.

The main features of these large thyroid cells and the other common thyroid cells are compared in Table I. Measurements of the nuclei were taken in order to find their exact difference in size. It is practically impossible to measure exactly the dimensions of the cell itself—which would be the more striking proof—because there are often no boundaries between the adjacent cells and the differences between the two cell types are more striking in the nuclei than in the cell bodies. Table II contains the results of the measurements taken on 100 nuclei of each group. The reader of this table should keep in mind that the

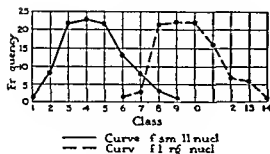


Fig. 1. Graph of frequency versus class for the two types of nuclei. The solid line represents the curve of small nuclei and the dashed line represents the curve of large nuclei.

TABLE I—MAIN DIFFERENCES BETWEEN THE LARGE AND COMMON THYROID CELLS

	Common thyroid cell	Large thyroid cell
Location	Interstitial, follicular, peripheral	Chiefly interfollicular, peripheral, subcapsular
Size	Small	Larger than common
Shape	Cuboidal, cylindrical	Irregular, rounded, multangular
Size of lumen	4 micra	6.3 micra
Shape of lumen	Spherical, multipolar	Irregular, polygonal, multipolar
Chromatin	Nucleus lightly stained	Nucleus lightly stained
Mass ratio between nucleus and cytoplasm	1:1 (nucleus:cytoplasm)	1:1 (nucleus:cytoplasm)
Typical appearance of two types	Thyroid follicle	Thyroid follicle

absolute difference of the nuclei is not only expressed by the size but also by the other features computed in Table I. Therefore it is of no importance that few of the largest individuals in the group of small nuclei will be of the same size as the few smallest nuclei in the large group. This explains also the crossing of the two curves in Figure 1 which is a graphic illustration of Table I. Tabulating the measurements and calculating the average size of the two types leads to the following

TABLE II—DIMENSIONAL DIFFERENCES OF THE NUCLEI OF THE TWO CELL TYPES AS DETERMINED BY MEASUREMENT OF 100 NUCLEI IN EACH TYPE

Posn on micrometer drum	N mbe measured (f ucl quie)		Classes f res	D b tion f lear res	
	S ll	La g		Small	La ge
3	3			8	
4	5				
5			3		
6					
7	7		4	3	
8	6				
9	8		5		
	3				
	5		6	4	
	9				
3	4		7	8	3
4	4				
			8	3	
6					
7			9		
8					
9		8			
3		4			
3		9			6
3		7			
33		7			7
34					
35		6			6
36			3		
37			4		
	99	99		99	99

*On per cent of nuclei measured in each type.

results: small nuclei have a diameter of 4.0 micra and the large nuclei a diameter of 6.3 micra.

The large cells which are located in the interfollicular cell groups often are surrounded



Fig 2 Drawing of a section through the thyroid of a dog. In the center, a group of large cells between five follicles, the nuclei with a distinct chromatin network, cell boundaries not distinct. Compare the large cells and the common thyroid cells in regard to color and to ratio between the mass of nucleus and cytoplasm. $\times 250$

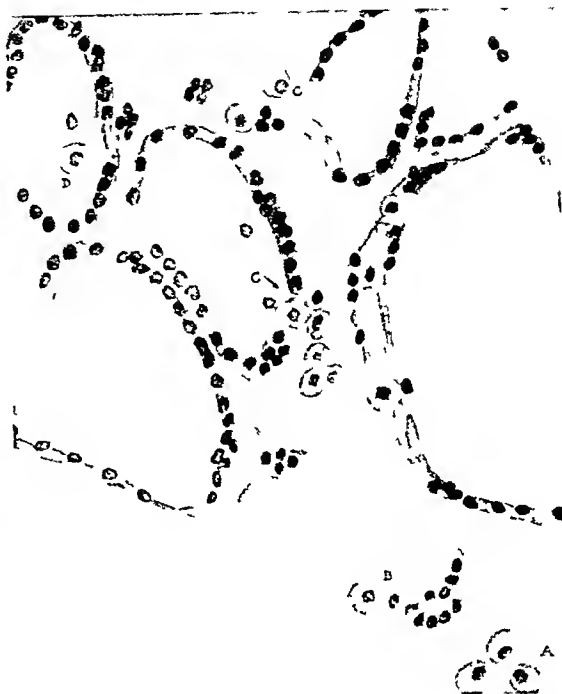


Fig 3 Composite drawing of different parts of the same section through the thyroid of a dog, demonstrating the relationship between large cells and follicles. A shows an insular group of three large cells, B, a large cell as part of the wall of a disintegrated follicle, C, large cells apparently invading interior of a follicle, D, a large cell inside follicle. $\times 125$

by colloid. Sometimes indeed, one is unable to distinguish between their cytoplasm and the surrounding colloid. Hence Langendorff



Fig 4 Photomicrograph of a section through the regenerating thyroid of a dog, 87 days after operation. The part of the follicular wall indicated with the arrow at *a* consists of large cells, immediately beyond the point of the rightmost arrow a small gap. The other arrows indicate groups of large cells scattered in a region of disintegrated and newly formed follicles. $\times 160$

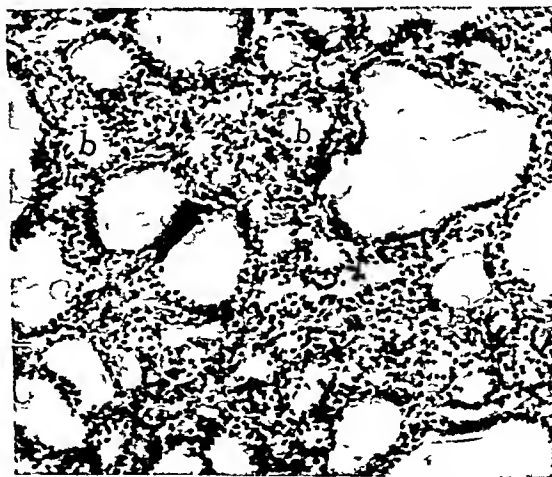
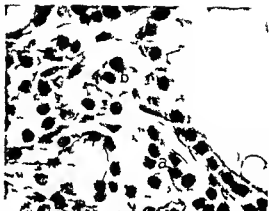


Fig 5 Photomicrograph of a section through the thyroid of a dog, showing the distribution of the large cells. The arrows not lettered point to cells with well marked nuclear chromatin nets, the ring includes a large cell with compact nucleus, arrow *a* points to a cell which is merged with extrafollicular colloid, the nucleus still remaining visible, *b*, extrafollicular colloid. $\times 160$



1 11 t m 2 ph f scet th gh th thy
 ru l f 12 h gl ll scet 1 th b t th
 f 11 1 ved ty t f y f m d p f ll
 f l 1 ll C mp th t f mm d l g l
 type t th i t t ee l l y t l m l th
 x



f 7 Ph i m rog ph f i th h h th thy
 i f d g f b p t th gro i f l l h
 ll X 100

the follicle 1: the initial step in the disintegration of follicles (Fig. 3 and 4, 7)

Because the large cells are so frequently associated with colloid—even with the free colloid located in the interfollicular spaces—in a small group of such cells may contain a droplet of colloid in its center the conclusion is near that they are engaged both in the production of colloid (like the common



1 g the m y h f sec h h th
 f f f ll gr f f l ll l
 l l ws Th h l ll be g f sec
 l l h m f l l d the 100



g l g gl f f f f f f th pera
N w l m t f f It les be wee la g f f }
l g m g f h f f u x

thyroid cells) and in the new formation of follicles. In this sense we may refer to them as "formative" cells. The amount of colloid in contact with the large cells is so small however that it is impossible to trace all the colloid back to this type of cell. The greater quantity of colloid is within the follicles and there is no doubt that the common thyroid cell plays the main rôle in its production.

Although there is a possibility that the large cells degenerate like any other cell they can not be regarded as representing a degenerating type of cell for the following reasons: (1) they assist in the new formation of follicles, (2) they possess nuclei with distinct chromatin networks, (3) they are more numerous in the regenerating gland than in the resting gland, and (4) they stain well with eosin. In regard to the last point it may be remarked that cells undergoing hyaline degeneration stain well with eosin but the large cells of the thyroid show nuclei that are not impaired and the other features mentioned support this conclusion.

SUMMARY

Two types of cells exist in the parenchyma of the thyroid gland: (1) the common thyroid cell which is the far prevailing type, and (2) the less frequent large cells. The large cells are located more often in the interfollicular cell groups than in the follicular wall and they

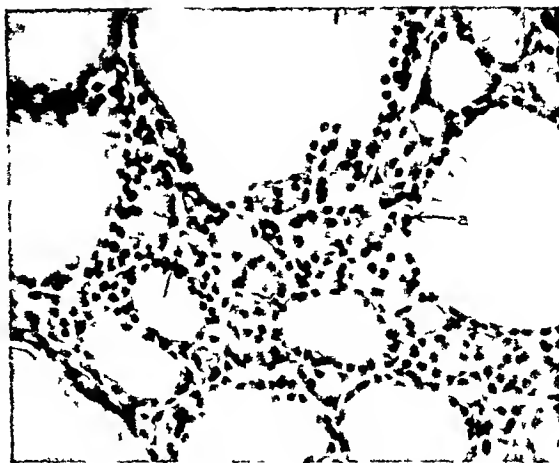


Fig. 10. Photomicrograph of a section through the regenerating gland of a dog 59 days after the operation. Many large cells are observed, *a* points to a large cell which is located within the follicular wall. $\times 225$.

occur in greater number in the regenerating than in the resting gland. They may be classified in two groups: those with nuclei possessing a distinct chromatin network, and those with nuclei staining densely and evenly. But the latter compose only a very small group.

In regard to the function it is believed that they are concerned: (1) with the formation of new follicles, (2) with the production of colloid, and (3) possibly with the inception of follicular destruction.

TUMORS OF THE BILE DUCTS¹

JAMES M. MARSHALL, M.D., ROCHESTER, N. Y.

Flow S. City Th. M. yo E. d. tu

THERE is probably no position within the human body outside the central nervous system where a growth while yet small is heralded by more widespread symptoms and is attended by more uniformly disastrous consequences than the lower end of the common bile duct. Tumors of the extrahepatic bile ducts offer one of the most difficult problems of modern surgery, both from the standpoint of diagnosis and of treatment. It is with the hope that careful clinical and pathological study of a group of these cases might lend additional aid in their treatment that this work was undertaken.

MATERIAL FOR STUDY

During the period of 20 years ending January 1, 1930 there were seen at The Mayo Clinic 4 cases of benign tumor and 49 cases of primary carcinoma of the extrahepatic bile ducts in which the diagnosis was confirmed by pathologic examination. Operation was performed in all but 4 of the cases. In these 4 complete results of necropsy were available as well as in 19 of the cases in which operation was performed. The clinical records of the 53 cases together with the specimens obtained at operation and at necropsy form the basis of this study.

BENIGN TUMORS

Benign tumors of the extrahepatic bile ducts are rare. Rolleston and McNece in 1929 mentioned only 10 cases, reports of which they had been able to find in the literature. These tumors are usually papillomatous, fibromatous, or adenofibromatous growths and cause symptoms by mechanical encroachment on the lumen of the involved ducts. Four cases of benign tumors of the ducts have been seen at The Mayo Clinic. Two were adenofibromata of the stump of the cystic duct following cholecystectomy, and the third was a papilloma of the cystic duct obstructing its lumen. In each of the first 2 cases mentioned there were symptoms of obstruction of the common

bile duct and obstruction was completely and permanently relieved by removal of the tumor.

Judd and Greene have reported a case of the fourth type of benign tumor of the extrahepatic bile ducts—the so called idiopathic or congenital cyst of the common bile duct to gether with a complete summary of 64 cases reviewed from the literature. Tumefaction due to parasitic invasion of the duct has been reported by Podwyszoński and by Devic and Gallavardin.

MALIGNANT TUMORS

Apparently the first case on record in which carcinoma of a bile duct was recognized as a distinct clinical and pathological entity was one of carcinoma of the ampulla of Vater described by McNeal in 1835. Since then cases have been reported with increasing frequency by Musser Miodowski W J Mayo and Outerbridge as well as by Rolleston and McNeer. The condition is not common but is not so extremely rare as it was formerly believed to be. In 4,578 postmortem examinations Kelynak found only 2 cases of primary carcinoma of the bile ducts and McGlenn found 5 in 9,000 postmortem examinations.

In the period of 20 years from January 1 1910 to January 1 1930 49 cases of primary carcinoma of the extrahepatic bile ducts were seen at The Mayo Clinic and were confirmed by pathological examination. Operation was performed in 45 cases and in the 4 remaining examination was by necropsy. During this period of 20 years more than 22 000 operations of all kinds were performed on the biliary apparatus. In 21 additional cases carcinoma of the ducts was thought to be present by the operating surgeon but since tissue was not removed and pathological confirmation therefore was not had these cases have been excluded from this series.

Etiology Until the cause of malignant invasion of the organism is known the cause of carcinoma in any particular situation cannot be known. Carcinoma of the bile ducts is more

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common in patients who have passed middle age. Three-fourths of the patients in this series were aged more than 50 years, the youngest was 23 years. Most observers are agreed that the disease is more common in males than in females. In this series 31 (62 per cent) of the patients were males and 18 (38 per cent) were females. Of the 15 patients with carcinoma of the ampulla of Vater 14 were males.

Both in the cases noted in the literature, and in this group, it was found that there were stones in the gall bladder or ducts in less than half. If stone was the principal etiological factor, malignancy might be expected to be more common in females than in males, but the opposite is the case. This is in striking contrast to carcinoma of the gall bladder, which is almost always associated with stones. In this series of 49 cases, gall stones were found in the gall bladder or ducts, or both, in 21 cases. In 5 additional cases there was definite evidence of cholecystitis without stones. Thus it will be seen that in 26 (53 per cent) there was associated disease of the biliary tract, whereas in 23 (47 per cent) the neoplasm was the only lesion present.

Rolleston adhered to the point of view that malignant change seems to start in a benign papilloma and reported a case in support of this. However, most papillomatous growths, when subjected to microscopic study, prove to be malignant. I have been able to find less than 12 cases of benign papilloma of the bile ducts in the literature. MacCarty has reported 2 cases of ulcer at the ampulla of Vater that suggest another possible origin of malignant neoplasm.

Pathology The most common sites of the tumors are the lower end of the common bile duct, and the ampulla of Vater. In this series of 49, in 4 of the cases the growth was situated in the right or left hepatic ducts, in 2, in the common hepatic duct, and one growth involved the point of union of the two hepatic ducts. In 5, the growth was confined to the cystic duct. There were 11 cases in which the tumor involved the juncture of the cystic, hepatic, and common ducts and 11 in which the common bile duct only was involved. In 15, the carcinoma was at the ampulla of Vater.



Fig. 1. Obstruction of long standing and carcinoma of the left hepatic duct that had spread to cause more recent occlusion of the right hepatic duct. There is extreme hydropneumatosis and marked atrophy of the left lobe of the liver. Jaundice had been present only 2 weeks.

Because of the strategic situation of the growths, and the early appearance of obstruction of the involved duct, most of the tumors are small. Edes has reported a case in which there was a history of obstruction for 15 months, and in which necropsy revealed a carcinoma about 1 centimeter in diameter at the lower end of the common bile duct. Most of the tumors are seen as localized, hard, white growths springing from the epithelial lining of the duct and infiltrating the submucous and connective tissue layers of the wall of the duct with projection into its lumen. Eventually this type of growth extends to involve the serosa, or an adjacent organ such as the liver, gall bladder, pancreas, or a contiguous duct. If the lesion is of the papillomatous type, the growth obstructs the lumen before there is any appreciable infiltration of the wall of the duct.

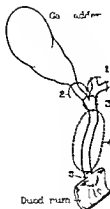


Fig. 3. The gall bladder and the common bile duct. The diagram shows the gall bladder and the common bile duct. The gall bladder is labeled 'Gall bladder' and the common bile duct is labeled 'Duodenum'. The diagram is numbered 1 through 5, indicating specific points of interest or obstruction.



Fig. 3. The gall bladder and the common bile duct. The diagram shows the gall bladder and the common bile duct. The gall bladder is labeled 'Gall bladder' and the common bile duct is labeled 'Duodenum'. The diagram is numbered 1 through 5, indicating specific points of interest or obstruction.

This is especially true of tumors in the ampulla of Vater which frequently project into the lumen of the duodenum and may ulcerate and bleed. I have seen in Livingston's laboratory observed a case in which a papillary carcinoma 3 millimeter in diameter just within the ampulla had caused a single fatal hemorrhage.

Microscopically most of the tumors have the structure of adenocarcinoma composed of columnar epithelial cells in various stages of differentiation. In only 4 of this series of 49 cases were the carcinomas of the papillary type with little if any tendency to glandular formation and these 4 were all tumors in the ampulla of Vater. Living emphasized the great amount of fibrous tissue troma to be seen in most of the tumors and this with the fact that a large proportion of the cells completely differentiated lead to the conclusion that most of the tumors are of a relatively low grade of malignancy.

Metastases from carcinoma of the bile ducts are not common and usually occur only late in the disease. In this series metastases to one or more organs were present in 2 of the 49 cases, the liver as involved in 9 cases, the regional nodes in the pancreas in 3 and the lungs in 1 case.

The ducts proximal to the obstruction are usually dilated and frequently do not contain bile but their content is the clear white mucous fluid that McMeatran and Rous found to be secreted from the mucous glands in the

walls of the obstructed ducts. This so-called white bile was encountered in 16 of the cases. Varying degrees of hepatic cirrhosis are seen depending apparently on the duration of the jaundice and the amount of infection present. Surprising degrees of hyaline hepatosis are seen in cases of long standing obstruction (Fig. 1). Pancreatitis in these cases is mostly seen as a complicating feature of growths around the ampulla where the pancreatic duct is obstructed by the tumor.

Symptoms and signs. Because of the position of the growth leading to early obstruction of the duct the usual clinical picture of malignancy of the ducts is that of obstructive jaundice. The picture varies with the situation of the growth and with the associated conditions such as cholecystitis, cholangitis, cholelithiasis and pancreatitis. The course is usually rapid with jaundice, loss of weight and strength and death within a period of months.

Jaundice was present in 44 of the 49 cases. In 4 of the remaining 5 cases in which jaundice was not present the lesion was confined to the cystic duct and in 1 case carcinoma of the ampulla of Vater was present. Cholecystectomy had been performed previously in 1 case. In 20 of the cases jaundice was apparently extreme constant and progressed from the onset. In 11 cases jaundice was constantly present but it varied in degree as evidenced by the value for serum bilirubin, the color of the stool and the receding of bile through drainage tubes. Definitely intermittent

tent jaundice was present in 11 cases, the jaundice entirely cleared up between attacks, but in 7 of these cases there were associated gall stones. In 2 cases the type of jaundice could not be ascertained from the record.

In the cases in which the icterus was constant and obstruction was complete, the average duration of jaundice before admission was 9 weeks, the longest duration was 10 months in 2 cases, in neither of which were stones present. In those cases in which the jaundice was constant but fluctuating, its average duration before examination was 15 weeks and its longest interval 10 months, in this case stones were not associated. In cases in which there was a history of intermittent jaundice, the average interval between the onset of jaundice and admission to the clinic was 22.7 months. However, in every case except one in which the jaundice dated back more than a year, gall stones were present. The exception was a case of carcinoma of the ampulla without associated stones in which there had been recurring jaundice for 18 months.

The degree of jaundice in the series varied from slight to extreme. In the 16 cases in which examination has been made since the van den Bergh quantitative test came into use, the average concentration of bilirubin was 15.7 milligrams in each 100 cubic centimeters of serum, the highest value was 36 milligrams. The reaction was direct in all.

Marked loss of weight was seen in 45 of the cases, the average loss was 22.4 pounds (10 kilograms). In many of the cases this was the outstanding symptom with the exception of the jaundice.

Pain was absent in 15 of the 49 cases during the entire course of the illness. Only 2 of these 15 patients, both of whom had carcinoma of the cystic duct, had associated stones. Of the remaining 34, the onset of the jaundice was painless in 8. Twenty gave histories of definite biliary colic, 5 of whom did not have associated cholecystitis or stones. The 14 remaining described the pain as dull or as aching soreness in the right upper abdominal quadrant.

Pruritus was a prominent symptom in 25 of the cases, in several it was the chief complaint. In 4 cases the itching preceded the jaundice,

in 15, the onset was simultaneous with the jaundice, and in 6, it followed the onset of jaundice.

Indefinite gastro-intestinal symptoms were common, particularly late in the disease and were described as bloating, belching, "indigestion," and intolerance to food. Acholic stools were present in most of the cases at one time or other, and in more than a third diarrhoea was present. Nausea with vomiting was a prominent symptom in 12 cases.

Chills and fever were present in 14 cases, in 5 of which there were associated gall stones. These symptoms were seen in 7 of the 15 cases of carcinoma of the ampulla, a considerably higher frequency than among cases in which growths were in the other situations.

Spontaneous hæmorrhage occurred in 16 cases. Ten patients had cutaneous petechiæ, 2, melena, 2 epistaxis, and 1 patient had metrorrhagia. In 1 of the cases in which operation was not done, hæmorrhage from a benign gastric ulcer was the terminal event.

The gall bladder was palpable in 19 of the cases.

The coagulation time was prolonged in most cases. The average time was 9 minutes, it was more than 10 minutes in 13 cases.

Anæmia was extreme in only a few cases, moderate anæmia of the secondary type was the rule.

DIAGNOSIS

The differential diagnosis of obstructive jaundice is notoriously difficult. Gall stones associated with the malignant lesion lend confusion. Moynihan's often quoted, "No one living is infallible in the differential diagnosis of obstructive jaundice, the diagnosis is always difficult and the chance of a life saved so important that I advise operation in all cases," seems to express the attitude of most surgeons today.

Crohn emphasized the importance of the use of the duodenal drainage tube in these cases. He wrote "Jaundice, remitting temperature of the 'septic' type, leucocytosis and blood in the duodenal content makes a diagnosis of ulcerating carcinoma of the ampulla." The duodenal drainage tube is used as a routine at The Mayo Clinic to determine the presence or absence of bile in the duodenum.



Fig. 1. Gall bladder and duodenum. 1. Gall bladder. 2. Neck of gall bladder. 3. Junction of gall bladder and duodenum.

Fig. 2. Gall bladder and duodenum. 1. Gall bladder. 2. Neck of gall bladder. 3. Junction of gall bladder and duodenum.

This is especially true of tumors in the ampulla of Vater which frequently project into the lumen of the duodenum and may ulcerate and bleed. Lippman in Evans's laboratory observed a case in which a papillary carcinoma 5 millimeters in diameter just within the ampulla had caused a single fatal hemorrhage.

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Metastasis from carcinoma of the bile duct is not common and usually occurs only late in the disease. In this series metastasis to one or more organs was present in 12 of the 49 cases, the liver was involved in 9 cases, the regional nodes in 5, the pancreas in 3 and the lung in 1 case.

The duct proximal to the obstruction are usually dilated and frequently do not contain bile but their content is the clear white mucous fluid that McVicker and Kuff found to be secretion from the mucous gland in the

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Jaundice was present in 44 of the 49 cases. In 4 of the remaining 5 cases in which jaundice was not present the lesion was confined to the cystic duct and in one carcinoma of the ampulla of Vater a pre-eruptive cholecystogastrostomy had been performed previously elsewhere. In 20 of the cases jaundice was apparently extreme and fatal progress from the onset. In 1 case jaundice was constantly present but it varied in degree as evidenced by the changes in serum bilirubin, the color of the stool and the frequency of biliousness. Drainage tube. Definitely intermittent

was done in 2 cases. One patient died in the hospital. The average duration of life after palliative drainage was 20 months. One patient lived comfortably 4 years and 3 months after cholecystogastrostomy and one lived more than 2 years after cholecystoduodenostomy.

Group 5 included the cases of carcinoma of the ampulla of Vater (Fig. 3), there were 15 in this series, in 13 of which treatment was surgical. Halsted, in 1859, reported the first radical resection of a carcinoma of the ampulla. He successfully performed transduodenal resection of the ampulla and lower 2 centimeters of the common bile duct and followed it with cholecystoduodenostomy. His patient lived 9 months. Since then the procedure has been modified by different surgeons with a growing tendency toward primary drainage by such an operation as cholecystostomy, choledochostomy, or cholecystogastrostomy for the relief of the jaundice, to be followed later by radical operation (1, 9, 12). In this series radical operation was done four times. Two patients died in the hospital, one patient lived 27 months (transduodenal resection and cholecystoduodenostomy) and one is living and well 2 years after transduodenal resection and cholecystogastrostomy. The best result from palliative operation in this group was obtained by cholecystogastrostomy, the patient on whom it was performed lived 3 years and 4 months.

POSTOPERATIVE COMPLICATIONS

Hæmorrhage was the most common complication, it occurred in 18 cases. In 8 cases hæmorrhage was the chief cause of death, and in 6 cases it was a contributing cause. It was present in 4 of the non-fatal cases. Bronchopneumonia was a factor in 3 of the fatal cases and in 3 in which the patients recovered. Peritonitis was present in 3 of the fatal cases in all of which the growth was at the ampulla of Vater. Suppurative pancreatitis and pyelophlebitis were seen at necropsy in 2 cases, and marked cholangitis in 2 others. Acute tubular nephritis occurred in 3 fatal cases, and in 3 others there was hæmorrhage into the pelvis of the kidney. Hepatic and renal insufficiency, due to cholæmia of long

standing, was common both in the fatal and in the non-fatal cases with high concentration of urea in the blood and partial or complete suppression of urinary secretion.

SUMMARY OF OPERATIVE RESULTS

Forty-five patients were operated on for carcinoma in the various situations named, of which 19 (42.2 per cent) died within 30 days. Twenty-six patients survived the operation for a known average postoperative life of 17.3 months. Three of the series were known to be still living, respectively, 7 months, 20 months, and 34 months after operation. Concerning 6 patients, the ultimate result is unknown.

In this series, patients with co-existent cholecystitis, cholelithiasis, or both, withstood the operations much better than those who had no disease other than the tumor. Of the 26 patients who had carcinoma of the bile ducts, associated with cholecystitis or cholelithiasis, 19 survived the operation and 7 died. In contrast to this, of the 19 patients who did not have associated cholecystitis or stones, 12 died from the operation and 7 survived. No explanation for this can be obtained from analysis of the causes of death in these two groups. Biometric analysis might show that the difference was not significant. However, those patients with infection of the biliary tract may have immunized themselves against infection at the time of operation. Another possible explanation is that the dilated and hypertrophied ducts found in the presence of infection are mechanically more suitable for surgical use than the small, thin walled ducts found in cases without infection.

SUMMARY AND CONCLUSIONS

1. Indications are that benign tumors of the bile ducts are extremely rare, that carcinoma is by far the most common neoplasm of the ducts, and that carcinoma of the bile ducts is more common in males than in females.

2. Gall stones were present in 43 per cent of the cases on which this study was primarily based.

3. Obstructive jaundice has been found in most cases, and may be extreme, fluctuating in severity, or intermittent.

TREATMENT

In the present state of knowledge surgical intervention offers the only hope of cure. Most authorities agree that operation should be performed if only for palliation. Erdmann and Heyd have expressed the belief that patients with malignant jaundice should be subjected to exploration because there is no absolute assurance that the pre-operative diagnosis is correct and operation will relieve the jaundice, pruritus and pain and will prolong the life of the patient in reasonable comfort. Judd wrote: "Too much significance should not be placed on the presenting symptoms in the differential diagnosis because on analysis it will be found that in a high percentage of malignant cases the presenting symptom will be colic and pain as well as jaundice. In cases of painless jaundice exploration should be done if the jaundice has persisted long enough to rule out catarrhal cholangitis and if the general condition of the patient warrants the belief that he will withstand the procedure without too great a risk. The cases usually constitute poor surgical risks chiefly on account of the jaundice and the tendency to bleed. They should be given supportive treatment prior to operation in the form of increased intake of fluid, diet high in carbohydrate, calcium and transfusions of whole blood."

Because the situation of the tumor determines the surgical procedures that might be attempted in a particular case it seems best to classify the cases in this regard. From a surgical standpoint it is all important to know whether the gall bladder and cystic duct are in open communication with the proximal or intrahepatic biliary ducts. Obviously it is useless to perform cholecystostomy or cholecyst enterostomy if the cystic duct is occluded or if the obstructing neoplasm is proximal to the cystic duct. Likewise tumors of the ampulla of Vater might be resected by the transduodenal route whereas those in other situations cannot. Therefore the cases are divided into 5 groups according to the accompanying diagram (Fig. 2).

In group 1 in which the growth involved the right, left or common hepatic ducts the tumor is usually not accessible for removal.

I have been unable to find an instance in which radical operation was attempted for such a tumor. Also palliative operations in this group are difficult because of the poor chance of getting drainage proximal to the growth. In this series there were 7 patients in group 1. Radical removal was not attempted in any of the 7 cases; the operations were merely explorations for diagnosis. Six of the patients died within 30 days. The remaining 1, a man with a carcinoma of the right hepatic duct, was living and free from jaundice when he last reported 7 months after operation. Cholecystostomy was performed and a considerable portion of the tumor was removed with a duct scoop and then a long armed T tube was placed up along the duct for drainage.

Group 2 included those cases in which the tumor was confined to the cystic duct. There were 5 cases in this group. Treatment in all of these was by radical removal of the gall bladder and cystic duct and in 3 cases by removal of the anterior wall of the common bile duct adjacent to the cystic duct. All patients survived the operation and lived for an average of 15 months and one patient was still living and well 3 years and 4 months after operation.

Eleven cases in this series were in group 3, in which the growth involved the junction of the cystic, hepatic and common bile ducts. In 8 cases palliative operation was done: cholecystostomy in 3, choledochostomy in 3 and cholecystogastrostomy in 2. Five of the patients died within 30 days, 1 lived 60 days, 1 lived 12 months and 1 recovered from the operation, left the hospital and was not again heard from. Three of these patients underwent radical operations with removal of the growth and involved ducts and anastomosis of the remaining portions of the ducts. All survived the operations. One patient lived 3 months. I have no details concerning the 2 others.

Group 4 included 11 cases in which the growth was situated in the common bile duct between the cystic duct and the ampulla of Vater. Nine of the 11 patients were treated surgically. Exploration was done in 2 cases with removal of tissue for diagnosis; palliative drainage of the gall bladder or common bile duct was done in 5 cases and side tracking anastomosis with the gastro intestinal tract

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2. Gall stones were present in 43 per cent of the cases on which this study was primarily based.

3. Obstructive jaundice has been found in most cases, and may be extreme, fluctuating in severity, or intermittent.

4 The presence or absence of pain seems to be of little if any diagnostic significance. Typical biliary colic is not uncommon with tumors of the bile ducts unassociated with cholecystitis or cholelithiasis.

5 The specific cause of obstructive jaundice is not easily diagnosed before operation. Positive diagnosis is rarely possible.

6 Obstructive jaundice is usually a surgical problem regardless of the type of lesion which causes the obstruction.

7 Surgical treatment should have a favorable effect because significant symptoms bring the patient to the physician early in the course of the disease and the tumor is small, slow growing and late to metastasize. Obstructive jaundice usually kills the patient before the tumor itself has passed the stage of operability.

8 Operation on tumors of the bile ducts carries a high mortality because of the tendency to hemorrhage and the technical difficulties of operation on the biliary tract. Favorable results are attainable.

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THE ASSOCIATION OF THE LIVER IN DISEASE OF THE BILIARY TRACT¹

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THE peculiar appearance of the surface of the liver frequently observed in the course of operations on the gall bladder and common bile duct is familiar to the majority of surgeons. There is no uniformity of opinion, however, as to the reason for this appearance or for the condition of the underlying hepatic tissue. The association of chronic cholecystitis with superficial scarring of the liver adjacent to the gall bladder usually leads to the loose diagnosis of chronic hepatitis. It is just as difficult for the surgeon to be certain of what is occurring within the liver, from superficial inspection of its capsule, as it is for him to estimate the degree of chronic pancreatitis by palpating the head and body of the organ and in this way determining the degree of its hardness or softness. The comparative rarity with which hepatic lesions of the type under consideration can be examined pathologically is another reason for the lack of understanding of their true nature. However, we now feel that, on the basis of our experience, and with a knowledge of the clinical history, it is possible, with a fair degree of accuracy, to estimate the extent and nature of the hepatic lesions in the majority of cases of surgical biliary disease.

Chronic cholangitis forms the basis of most microscopically recognizable lesions of the liver associated with infection in the gall bladder, with or without obstructive lesions of the common bile duct, but the condition appears in a large number of different forms and under a variety of circumstances. Its early stages are microscopic and the changes are found with difficulty, its later stages may scarcely be distinguished from portal cirrhosis of the hobnail type. We have defined cholangitis as an inflammatory process occurring in and around the walls of the intrahepatic and extrahepatic bile ducts, varying from simple scar of the lining epithelium to marked lym-

phocytic and polymorphonuclear leucocytic infiltration of the connective tissue of the entire portal spaces. Associated with this there is proliferation of fibrous tissue leading to tremendous thickening of the walls of the ducts. This description must be modified by the statement that although in most cases the changes are confined to the bile ducts proper they may extend to the intercellular bile canaliculi and may there produce the condition known as biliary cirrhosis.

THE IMPORTANCE OF INFECTION IN THE ETIOLOGY OF HEPATITIS AND CHOLANGITIS

It must be considered that the infection in these cases may be hematogenous. The usual conception of chronic cholangitis is that it is the result of obstruction of the common bile duct, with ascending lymphatic infection of the walls of the duct and portal spaces, or that it is the result of ascending infection of the stagnant bile. This is the problem as it presents itself to the surgeon at the time of operation.

At the beginning of this year, we undertook a study of the bacteriology of the liver to see how frequently we would be able to recover organisms from the liver in cases in which there was gross hepatitis associated with gross cholecystitis. It is a well known fact that placing of a free portion of a dog's liver, obtained with strict aseptic precautions, in the general abdominal cavity of an experimental animal regularly causes the death of the recipient animal in from 1 to 3 days. The cause of the death of these animals has been repeatedly discussed by different investigators (Dragstad, Wangensteen, and Mann). Dragstad has recently felt that he has recovered an organism which is responsible for peritonitis, which in turn causes the death of these animals.

The studies which we carried out began with removal of a piece of liver at the time

¹Read before the Medical Society of the Missouri Valley, Des Moines, Iowa, October 16, 1930.

TABLE I

Source	Cultures	Post		Cultures from	
		Number	Percent	Stomach	Other
Liver	3				
Gall bladder	3				

Results of cultures by different methods: 1. From the liver: 3 cultures, 100% positive. 2. From the gall bladder: 3 cultures, 100% positive. 3. From the stomach: 3 cultures, 100% positive. 4. From other sites: 3 cultures, 100% positive.

of operation on the gall bladder. A fair sized piece of liver was taken from the right lobe in certain instances whereas in other instance a piece of the same size was taken from the left lobe of the liver at some distance from the gall bladder. The piece of liver was removed at the beginning of the operation before the gall bladder had been disturbed. This was immediately subjected to bacteriological study. This hepatic tissue was cultured with the use of several different culture mediums. The cultures were incubated at room temperature and at 37 degrees C. They were cultured aerobically anaerobically and in an atmosphere of carbon dioxide 10 per cent. They were incubated for at least 2 weeks before being discarded. Cultures of the gall bladder were similarly made.

Culture of the liver as well as of the gall bladder were made in 30 instances and in 7 instances in which the gall bladder was not removed cultures of the liver only were made (Table I). Therefore cultures of the liver numbered 37 and of the gall bladder 30. Of the 37 cultures made from the liver 7 per cent were positive 14 per cent yielded streptococci and 17 per cent other organisms. From the figures it is evident that a few cultures of the liver contained both streptococci and other organisms. Of the 30 cultures made from the gall bladder 47 per cent were positive 7 per cent contained streptococci and 23 per cent other organisms. A few of these cultures also contained streptococci and other organisms. As has been noted in 7 cases cholecystectomy was not indicated and cultures were made of the liver only. If these are taken as a separate group the results of culture are as follows: 51 per

TABLE II

Strain	Source	Reaction	Pathology	
			Gall bladder	Liver
Streptococcus	Gall bladder		+	
	Liver			+
Diphtheroid	Gall bladder		+	+
	Liver		None	+
Staphylococcus	Gall bladder		+	+
	Liver		None	+

Electron localization of the strains isolated from the gall bladder and liver. The results show that the gall bladder contains bacteria about twice as often as the liver. The streptococci isolated were always of the indifferent or green producing variety. The other bacteria were mainly diphtheroid organisms, staphylococci, and various bacilli. None of the bacilli isolated resembled bacillus welchii in any of its essential properties.

sterile 1 yielded a streptococcus and 1 a Gram negative bacillus of the colon typhoid group.

The occurrence of streptococci in 27 per cent of the gall bladders agrees with the percentage incidence of cultures of the gall bladder in which streptococci have been obtained previously. These results show that the gall bladder contains bacteria about twice as often as the liver. The streptococci isolated were always of the indifferent or green producing variety. The other bacteria were mainly diphtheroid organisms, staphylococci, and various bacilli. None of the bacilli isolated resembled bacillus welchii in any of its essential properties.

The results obtained by injecting into rabbits the various strains isolated are given in Table II. The streptococci isolated from the gall bladder were selective for the gall bladder of the rabbit but also localized in the liver to a lesser extent. Those isolated from the liver were not as selective in their action. The diphtheroid organisms isolated had practically no selective localizing power and like the staphylococci and bacilli did not produce any experimental focal lesion. All of the strains were injected intravenously. The Gram positive bacilli were also injected intraperitoneally in doses of 2 to 3 cubic centimeters of suspension but none of the strains was virulent enough to produce death of the animals.

This bacteriological study of the liver as well as of the gall bladder would seem to show

that (1) streptococci were isolated from the gall bladder in the usual percentage of cases and more frequently than they were isolated from the liver, (2) when these streptococci were injected into rabbits they displayed a certain degree of elective localizing power, (3) staphylococci, diphtheroid organisms, and bacilli were isolated less frequently, did not have definite elective localizing power, and were not pathogenic for rabbits when injected in the same dosage as that in which streptococci were introduced, and (4) none of the organisms resembled the description given by Dragstad of the organisms responsible for death of experimental animals from implantation of hepatic tissue

HISTOLOGICAL STUDIES

Histological as well as bacteriological studies were made of specimens taken from the liver and also of specimens taken from the gall bladder. These studies were made from fresh sections and from fixed frozen sections of the same material as that used for the bacteriological work. Several different stains were used in carrying out this study.

The walls of the gall bladders varied in color and thickness, some were thin, and of a bluish, nearly normal appearance, others were thick, fibrous, and grayish-white. The wall of the gall bladder, as is well known, is composed of several layers. From within outward they are as follows: (1) the mucosa, which consists of a glandular, villous structure, lined with columnar epithelium, (2) the submucosal vascular stroma of connective tissue, (3) the muscularis, which is made of two layers, the circular and the longitudinal intricately arranged, and working in unison for the purpose of expressing the bile, and (4) the serosa or outermost layer consisting of thin endothelial connective tissue which contains a variable amount of fat.

The condition of the walls of the gall bladders varied greatly with the extent of the inflammation. In some it was nearly normal in certain areas except for slight congestion of the capillaries and a little lymphocytic infiltration in the submucosa. In 2 cases the inflammatory process was extensive and severe because of both scattered and collected active

lymphocytes and a few plasma cells, in all layers, along with an increase of fibrous connective tissue.

Cholesterosis was present in 5 specimens in this series. However, on microscopic examination, 12 were found to contain a variable amount of this lipoid material in the submucosa of the villi. The lipoid substance was mostly present in the phagocytic cells collected in the villi and was also found in a minute form in the cytoplasm of the epithelium. Stones which occurred in the gall bladder were either of the single, olive-shaped, cholesterol type or of the small multiple, mulberry variety.

Twenty-four of the gall bladders contained two or more stones of variable color, variety, and shape. The injury to the mucosa varied from a slight brushing off of the villi to almost complete destruction. In many gall bladders there were areas of low glandular epithelium, in other areas, thickened submucosal fibrosis which was covered by a single layer of low columnar epithelium. The amount and extent of inflammatory cellular infiltration varied. In a few gall bladders, the wall consisted of nothing more than dense, fibrous, hyalinized tissue which even contained some deposit of calcium. In those which contained fewer stones than others, and in cases in which the history of disease was of shorter duration, there was much less evidence of previous or present disease. The muscularis in some was destroyed, in others there was hydropic degeneration, with poorly staining cellular nuclei.

In 50 per cent of the gall bladders in this series there were glandular structures within the musculature, which in a few cases extended into the serosa. These were heterotopic glands similar to those in the mucosa, many of which were partly surrounded by lymphocytes. In 2 cases in which stones were not present, these heterotopic glands were present. Their presence may, in some instances, explain the symptoms in a manner similar to that in which glandular structures in the uterine wall may explain symptoms referable to the uterus. They may also be a potential source of adenocarcinoma of the gall bladder.

In some cases the inflammatory reaction in the liver consisted of portal cirrhosis to a vary-

TABLE I

Source of culture	Cultures made	Pos		C I rest m h l la of pe	
		N	P	S ep of l	Other bacte
Liver					
Gall bladder					

Result of cultures from gall bladder perat w

of operation on the gall bladder. A fair sized piece of liver was taken from the right lobe in certain instances whereas in other instances a piece of the same size was taken from the left lobe of the liver at some distance from the gall bladder. The piece of liver was removed at the beginning of the operation before the gall bladder had been disturbed. This was immediately subjected to bacteriological study. This hepatic tissue was cultured with the use of several different culture mediums. The cultures were incubated at room temperature and at 37 degrees C. They were cultured aerobically and anaerobically and in an atmosphere of carbon dioxide 10 per cent. They were incubated for at least 2 weeks before being discarded. Cultures of the gall bladder were similarly made.

Cultures of the liver as well as of the gall bladder were made in 30 instances and in 7 instances in which the gall bladder was not removed cultures of the liver only were made (Table I). Therefore culture of the liver numbered 137 and of the gall bladder 30. Of the 3 cultures made from the liver 27 per cent were positive. 14 per cent yielded streptococci and 9 per cent other organisms from the culture. It is evident that a few cultures of the liver contained both streptococci and other organisms. Of the 30 cultures made from the gall bladder 47 per cent were positive. 27 per cent contained streptococci and 23 per cent other organisms. A few of the cultures also contained streptococci and other organisms. As has been said in cases of cholecystectomy was not indicated and cultures were made of the liver only. If these are taken as a separate group the results of culture are as follows: 5 were

TABLE II

Source of culture	Cultures made	Pos	C I rest m h l la of pe	
			S ep of l	Other bacte
Liver				
Gall bladder				

Flect localization of st isolated from perat wa performed f d of th bl ry

sterile 1 yielded a streptococcus and 1 a Gram negative bacillus of the colon typhoid group.

The occurrence of streptococci in 27 per cent of the gall bladders agrees with the percentage incidence of cultures of the gall bladder in which streptococci have been obtained previously. These results show that the gall bladder contains bacteria about twice as often as the liver. The streptococci isolated were always of the indifferent or green producing variety. The other bacteria were mainly diphtheroid organisms, staphylococci and various bacilli. None of the bacilli isolated resembled bacillus welchii in any of its essential properties.

The results obtained by injecting into rabbits the various strains isolated are given in Table II. The streptococci isolated from the gall bladder were selective for the gall bladder of the rabbit but also localized in the liver to a lesser extent. Those isolated from the liver were not as selective in their action. The diphtheroid organisms isolated had practically no selective localizing power and like the staphylococci and bacilli did not produce any experimental lesion. All of the strains were injected intravenously. The Gram positive bacilli were also injected intraperitoneally in doses of 2 to 3 cubic centimeters of suspension but none of the strains was virulent enough to produce death of the animals.

This bacteriological study of the liver as well as of the gall bladder would seem to show

CHOLECYSTOGRAPHIC CRITERIA IN SURGICAL DIAGNOSIS

AN ANALYSIS AND OPERATIVE CHECK IN 233 PATIENTS¹

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LABORATORY and technical tests designed to aid in diagnosis are frequently introduced to the medical profession with claims of value that are not borne out by subsequent use. Cholecystography seems, in some part at least, to be a welcome exception. Since its introduction in 1924 by Graham, Copher, and Cole it has been very widely used. It is unusual today to have a patient come to operation for biliary tract disease whose cholecystogram has not been previously studied. Though it was primarily introduced as a diagnostic aid without present knowledge of its significance, it has come to be recognized as a test of gall-bladder function, and it has been so considered in this investigation.

Much of the literature on this subject has been contributed by the roentgenologist. We have approached it from the viewpoint of the clinician or surgeon and, therefore, have not been concerned with the technical production of the cholecystograms nor with the interpretation of the films, but rather with the criteria that has been offered by the roentgenologist. It should be known that the oral administration of the dye has been used routinely in our patients, but results have been frequently checked by the intravenous method of administration.

In considering cholecystographic findings one must recall the factors outside the gall bladder and bile ducts which prevent or hinder its visualization. Chief among those found by other observers are enlargement of the liver (cirrhosis—passive congestion), jaundice, pregnancy after the fifth month, malignant disease of the upper right abdominal quadrant, ascites, or any acute intra-abdominal disease. Roentgenologists have found that in very obese patients it is not always possible to visualize the gall bladder even when normal. This is particularly true when co-operation cannot be secured either through the patient's lack of intelligence or of an understanding of the English language. Colonic irritability or instability is sometimes attended by a failure of the gall bladder to fill after administration of the dye. Lahey and Jordan have recently reported 65 such patients and pointed out that after treatment had been carried out for their colonic symptoms, 44 per cent gave normal cholecystograms. The importance of this observation needs em-

phasis for symptoms originating in the colon may closely simulate those of biliary tract disease.

Cholecystography depends upon three known functions of the gall bladder: the storage of bile, its concentration therein, and its expulsion on demand into the duodenum. The dye used in this test must have access to the liver which organ secretes it in the bile by means of which it is carried to the gall bladder. Adequate liver function, patent bile ducts, and concentration within this viscous are all essential to visualization. Obviously, unless the gall bladder is visualized, nothing may be learned, by this method of examination, of its size, position, shape, or ability to empty. It must follow, therefore, that the one particular gall-bladder function of which most is learned is the ability to concentrate its fluid contents.

Olech (1927) found that of 52 cases of chronic cholecystitis without stones only 10 showed an abnormal mucosa at operation and in no instance was the mucosa found abnormal microscopically, and yet the cholecystograms of all indicated impaired function. Such findings show the difficulty of interpreting function in terms of histopathology. Graham, Lahey, and Kirklin all have remarked upon the difficulty experienced many times in distinguishing macroscopically or microscopically between a normal and an abnormal gall bladder.

Lockwood and Skinner found that in 89.6 per cent of 192 cases having gall stones, the cholecystograms indicated pathological changes in the gall bladder. Case reported that the cholecystographic findings were correct in 96.1 per cent of his cases with gall stones. Ninety-four and one tenth per cent of Wilson's patients with stones showed impaired function of the gall bladder. Most authors commenting on this phase agree that impaired function, as revealed by the cholecystogram, has a higher incidence in the gall bladders containing stones.

Eusterman reviewed 1,510 reports of patients in all of whom positive cholecystograms had been produced. In 41 per cent of these the clinical symptoms or signs of gall-bladder disease were absent or indefinite. He rightly emphasized the need for the realization that cholecystographic criteria must not be accepted as a diagnosis. Murphy, Kirklin, and Graham all found that the

¹From the Surgical Department, Division B of the Jefferson Hospital.

in degree together with sclerosis of the blood vessels. In other cases it consisted of perivascular infiltration together with fibrosis or in some instances even hyalinization. These processes in a few cases extended between the columnar hepatic cells and the cells occasionally showed some evidence of disease by the presence of poorly staining or small nuclei. In four sections of the liver there were collections of lymphocytes in the lobules as additional evidence of hepatic infection. The reaction varied in amount and apparently it was not in direct relationship to the degree of reaction in the gall bladder. This was shown by MacCarty and Jackson in a similar study in 1920.

In all sections of the liver which were stained with Sudan III fat was present in varying amounts mostly within the hepatic cells. In these sections which contained a large amount the fat was seen to occur radially about the central vein. Since there were deposits of lipoid in only twelve gall bladders there was no indication of direct relationship between deposits of lipoid in the two organs.

SUMMARY

It is certain that this condition of hepatitis or cholangitis occurs routinely in the presence

of cholecystitis. It is also true that this condition of the liver exists when recognizable change cannot be made out in the gall bladder or bile ducts. Probably under these conditions hepatitis is secondary to infection in some part of the portal system. It is a well known fact that the liver has a marked detoxifying function and that these changes in the hepatic tissue at times may represent the reaction that has taken place as a result of neutralizing either bacterial or chemical toxins that have been brought to the liver by the portal circulation.

We feel sure that hepatitis may occur as a primary condition and that the symptoms which result from it are similar to those of cholecystitis. Furthermore removal of the gall bladder in these cases of primary hepatitis will relieve the symptoms.

In the group of cases studied it was clearly shown that bacteria can be found in a certain proportion of these cases. It was difficult however to establish the importance of these bacteria from the standpoint of the hepatic change. The virulence of the organisms which were recovered from the liver was not great. Further studies along these lines may possibly tell more concerning the importance of these bacteria.

These findings indicate that a gall bladder may be diseased sufficiently to give rise to symptoms leading to a positive clinical diagnosis and such diagnosis be confirmed at operation and still the cholecystographic response be normal. In those in which the diagnosis was confirmed by the histopathologist, 11.9 per cent (14 of 117) had normal function. There were 188 patients having clinically positive gall-bladder disease plus disturbed function as revealed by the cholecystogram, and of these only 8, or 4.2 per cent, were found normal by the surgeon. Of 8 gall bladders found normal by the surgeon, 7, or 87.5 per cent, gave normal cholecystograms. Four normally functioning gall bladders containing stones were reported.

CHRONIC CHOLECYSTITIS WITHOUT STONES

Of 78 patients found to have chronic cholecystitis without stones, 17, or 21.8 per cent, all checked at operation and, by the histopathologist, gave normal cholecystograms. This indicates quite clearly that the group of patients that presents the greatest difficulty to the clinician and surgeon in clinical diagnosis is the same group in which the gall bladders show the greatest variation in function.

TABLE II — SURGEON'S FINDINGS AT OPERATION¹

	Gall bladder not visualized	Gall bladder poorly visualized or abnormal	Normal dye response	Total
Diseased with stones	63	54	7	124
Diseased without stones	23	38	17	78
Normal	3	5	7	15
Total	91	97	31	119

¹All patients operated on primarily for biliary tract disease.

The surgeon found 78 diseased gall bladders without stones (Table II). Seventy-eight and two-tenths per cent of these had disturbed function as contrasted to 94.4 per cent of the patients with stones. Twenty-nine and five-tenths per cent of the gall bladders were *not visualized* as contrasted to 51.6 per cent in those having stones. Forty-eight and seven-tenths per cent had *impaired function* as contrasted to 42.8 per cent in those with stones but 21.8 per cent had normal functioning gall bladders while only 5.5 per cent were found in patients with stones.

There are 120 patients on whom histopathological reports are available (Table III). In the group showing impaired gall-bladder function

TABLE III — HISTOPATHOLOGICAL FINDINGS

	Gall bladder not visualized	Gall bladder abnormal or poorly visualized	No mal dye response	Total
Abnormal with stones	34	2	4	60
Abnormal without stones	12	35	10	57
Normal without stones	0	0	3	3
Total	46	37	17	100

¹120 patients operated on primarily for biliary tract disease.

100 per cent were found abnormal by the pathologist. The only gall bladders reported normal by the pathologist were from the group showing normal dye response.

SUMMARY AND CONCLUSIONS

Correct pre-operative clinical diagnosis as checked by the surgeon at operation was 93 per cent. Eighty-eight and two-tenths per cent found by surgeon to have gall-bladder disease had disturbed gall-bladder function revealed by the cholecystogram. Eleven and seven-tenths per cent had normal gall-bladder function. The pathologists found no normal gall bladders in a smaller number (120) with clinically positive gall-bladder disease and impaired function revealed by cholecystography.

Ninety-four and four-tenths per cent of the patients with stones had impaired or lost gall-bladder function. Stones were found by cholecystography in 50 per cent of all patients with gall stones.

In the patients found to have gall-bladder disease *without* stones, the function was not only disturbed *less frequently* but to a *less degree*. Of these non-stone cases 28 per cent had normally functioning gall bladders. These patients represent the group (chronic cholecystitis without stones) that likewise presents the greatest difficulties in clinical diagnosis. In cholecystography, as in any other functional test or laboratory determination, a knowledge of limitations is as essential to usefulness as a knowledge of possibilities.

Of all patients having clinically positive gall-bladder disease and disturbed function as revealed by the cholecystogram, only 4.2 per cent were found normal by the surgeon. This emphasizes the value of positive clinical opinion in conjunction with positive cholecystographic findings.

A normal cystogram from a patient suspected of having gall-bladder disease is not to be inter-

gall bladder can recover spontaneously from acute disturbances which lead to its non visualization by cholecystography and the latter contends that the cholecystogram in itself is therefore not an indication for the removal of the gall bladder.

It has been pointed out by Lusterman and Case that valuable data on the accuracy of the cholecystogram are not available because all patients showing impaired gall bladder function are not subjected to surgery and the more reliable check can be had. The latter further reminds us that positive cholecystographic findings controlled by operation should also be controlled by an equal number of negative cholecystograms checked by operation. However, interesting and useful such information would be it does not seem essential unless one means to rely entirely on the cholecystogram for diagnosis.

Kirklin reported that the normal cholecystogram is relatively less reliable than the abnormal one. This seems to be in keeping with the findings of most authors. There is need for great care in the interpretation of the normal cholecystogram in patients clinically positive for gall bladder disease.

The writer has shown that surgically drained gall bladders do not regain normal function as revealed by the cholecystogram and the latter is of no use in the evaluation of symptoms and subsequently in these patients. A patient may be symptom free with a completely non-functional gall bladder.

Summary. We may say cholecystography is a method of studying gall bladder function. The effectiveness of which it gives most information is the percentage of concentration of its content and this is most often found impaired in gall bladders containing stones. Cholecystograms showing normal response have been found in a table when attempting to interpret them in terms of symptom or pathologic change in the organ. No sharp line of demarcation between the normal and abnormal gall bladder has been determined by the histopathologist's grade. Data are not available which help in determining the percentage of cholecystographic cases which have been checked by operation. Cholecystography is therefore to be accepted as a diagnostic test in and at itself for removal of the gall bladder. A knowledge of the effectiveness of factors that may interfere in the production of a cholecystogram is essential in interpreting reports.

In this investigation we have attempted to correlate cholecystographic criteria of patients operated on primarily for biliary tract disease with the findings of the surgeon and the histopathologist. We were interested also in determining whether there may be disturbance of a gall bladder sufficient to lead to a positive clinical diagnosis and impaired function detectable by cholecystography without pathological change in the organ.

At the outset it was our intention to make use of 200 consecutive cases operated on from the surgical ward of the Jefferson Hospital for gall bladder disease. Additional records have become available and to this group 33 were added making a total of 233 consecutive cases. It was necessary to omit 14 records because their information was inadequate. It is important to note that all patients considered herein were operated on primarily for biliary tract disease and with that clinical diagnosis. The findings by cholecystogram as reported from the roentgenological department have been compared with the surgeon's findings at operation and when available with the histopathological reports.

CHOLECYSTITIS WITH STONES

TABLE I—CHOLECYSTOGRAPHIC FINDINGS¹

	W h m	W h m	Total
Gall bladder not visualized			
Gall bladder positive			
Normal gall bladder			
Total			
A	p	m	f

Gall stones were found at operation in 119 patients. Sixty of these are reported; the cholecystographic criteria but 94 percent of these stone cases showed impaired or entirely lost gall bladder function (Table I). Of the 219 patients considered 93 percent were found by the surgeon to have diseased gall bladders. It is not to be inferred that the final preoperative diagnosis were not frequently influenced by the cholecystographic findings. The latter here are added to the clinical diagnosis as evidenced by the fact that 33 percent gave normal cholecystogram.

NORMAL CHOLECYSTOGRAMS IN CLINICALLY POSITIVE GALL BLADDER DISEASE

Eighty-eight and two-tenths percent (180 of 204) of the gall bladders found diseased by the surgeon had impaired function. Eleven and one-tenth percent (24 of 204) gave normal cholecystographic response.

SYMPTOMS AND SIGNS

According to Keefe, the symptoms vary with the nature and seat of the antecedent disorder, the pathway of infection, and the nature and virulence of the infectious agent. The onset may be insidious, but it is usually abrupt, accompanied by sharp, shooting pain in the right upper quadrant, and associated with a sense of fullness in the epigastrium, or oppression in the lower right portion of the thorax. Additional symptoms are headache, profuse sweating, nausea, anorexia, gradual loss of weight, emaciation, irritability, lassitude, dry cough, and fever of the remittent type. Frequently spontaneous improvement occurs, followed by periods of recurrence of symptoms.

The temperature usually fluctuates between normal and 105 or 106 degrees F. The rapidity of loss of strength and weight may even lead one strongly to suspect malignancy. Tenderness under the right costal margin is frequently present and usually can be elicited by one or more methods. Tenderness in the region of the abscess is said always to be present as a result of direct stretching by the abscess of the liver. However, some difficulties may be encountered in eliciting this most important sign in the usual way. Deep fistic percussion generally succeeds. Ludlow has called attention to a special sign for revealing the usual deep seated pain of hepatic abscess by a sudden thrust with the end of the finger. The usual point at which this sign appears is within the ninth intercostal space, about 5 centimeters from the right costal margin. Pain is an inconstant symptom, but when present it is significant. It may even be vague intra-abdominal or intrathoracic distress. Increased intrahepatic pain on pressure, however, must be distinguished from disease of the gall bladder or kidney, and from ulcer of the stomach or duodenum. Thoracic pain as a result of pressure and displacement is sometimes more easily interpreted. Pain in the right shoulder, when present, is the result of pressure on the endings of the phrenic nerve.

Jaundice may be present from the start, or it may come on very early. It usually persists and fluctuates in intensity during the

course of the disease. Hepatic dullness is increased, dependent on the situation of the abscess. Enlargement and tenderness in the right upper abdominal quadrant is the usual observation, whereas hepatic abscess on the left side is uncommon. The right side of the diaphragm is very likely to be elevated, to have little, if any, excursion, and to be associated with impaired resonance of the lower part of the right lung. Edema of the anterolateral aspect of the thoracic walls extending from the sixth to the eighth interspace, is considered by many as a pathognomonic sign of hepatic disease. However, its appearance is so delayed in the course of the disease that it rarely influences the diagnosis. Enlarged spleen is common but fortunately makes its appearance late. Nevertheless malaria too frequently has been suspected in these cases.

LABORATORY RESULTS

Anæmia is of the secondary type, and progressive, with marked destruction of blood cells. Regenerative powers of the hæmatopoietic organs apparently cannot keep pace with the increasing anæmia. Leucocytosis is present and may be high. Frequently the leucocyte count is only slightly elevated and remains undisturbed during violent changes in temperature. Roentgenologic studies may give entirely negative results, or they may offer valuable assistance. Fluoroscopic examination frequently reveals elevation of the dome of the diaphragm on the affected side with restricted movement. Pulmonary reaction of the adjacent lobe may be a confusing observation, and may lead to the diagnosis of basal pneumonia. Following rupture of the abscess beneath the diaphragm, the diagnosis of hepatic abscess may seem unwarranted. Finally, on perforation of the diaphragm, with the admission of pus to the thoracic cavity, the diagnosis of empyema or pleurisy with effusion may seem to be assured without any suspicion as to the presence of the hepatic abscess. Undoubtedly, there are instances in which a ruptured pyogenic abscess of the liver has been treated as empyema, with good results. Perirenal abscess likewise may be impossible to exclude. Artificial pneumoperi-

preted as trustworthy evidence against the presence of such disease

Cholecystographic criteria in diagnosis are adjuncts and are of value only when interpreted in conjunction with the clinical history and findings and after all known extracystic factors that may interfere in its production have been eliminated

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PRIMARY IDIOPATHIC ABSCESS OF THE LIVER

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D i s t r I S u r g T h f C t

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F l o r e T h f u o d

The etiology of idiopathic abscess usually obscure. However abscess of the liver of bacterial cause may take origin in the bill of trauma of the portal vein. In all this infection may enter the liver by way of the bile ducts hepatoduodenal junction or extension may be by way of the lymphatic channel and by direct trauma. However bacteria carried to the liver do not always undergo proliferation but often fortunately are destroyed by the hepatic tissue.

It is now called attention to the fact that the incidence of hepatic abscesses is increasing in frequency from most of the past century. The firm belief that the most important cause of hepatic abscess is suppuration of the appendix inasmuch as nearly 50 per cent of all pyogenic hepatic abscesses may be said to have their origin at this focus. The sequence of acute suppurative appendicitis complicated by thrombosis in the meso-

appendix and followed by infectious embolism through the portal system later to terminate in an abscess of the liver has been well established. However ruptured duodenal ulcer with associated hemorrhoidal vein suppurative cholangitis colitis acute pancreatitis furunculo is typhoid fever intestinal obstruction and operation on the gall bladder have been credited as the predisposing factor in some cases. The common causative organisms of primary hepatic abscess are staphylococci streptococci pneumococci and agnate bacilli pyocyanus diploccus pneumoniae and others. Often however bacterial growths are multiplied because of the frequent occurrence of secondary invading organisms.

The age at which abscess of the liver is most likely to occur is that at which appendicitis is most likely to occur. Males are apparently more susceptible than females.

duration and unassociated with gastro-intestinal symptoms. The temperature rose to 103.2 degrees F, leucocytes numbered 14,000 in each cubic millimeter of blood, and the concentration of hæmoglobin was 45 per cent. The patient looked sick and was unco-operative. General examination revealed a stiff neck and a bilateral positive Kernig sign graded 2. His handgrips were weak. The abdomen was not satisfactorily palpated because of voluntary rigidity. The diagnosis was indeterminate, but the suggestion was made that generalized infectious myositis might be present.

On the third day in hospital the pain disappeared entirely, and the patient felt well except for weakness. Examination revealed jaundice of the sclera and skin, graded 1 to 2. The abdomen was still distended, but the rigidity seemed voluntary. There was dullness to percussion in the right upper quadrant, and questionable firmness. Evidence of definite anaemia had developed since examination in the clinic. The patient was eating well and his bowels were functioning satisfactorily. On the fourth day in the hospital his general condition remained satisfactory, but he was still febrile. Examination revealed tenderness, graded 2, over the right kidney, posteriorly, laterally, and at the middle portion of the abdomen, anteriorly, on the right side. The right side of the diaphragm was definitely elevated. Roentgenologic examination did not disclose abnormality within the thorax. Perinephritic and subdiaphragmatic abscess were considered.

November 19, the patient complained of severe pain at the lower end of the sternum, and there was rigidity, tenderness, and dullness in the right upper quadrant of the abdomen. The question of exploration was imperative. It was not considered wise to explore because of the poor surgical risk and the probability of a malignant process being present.

The following possibilities were considered: empyema of the gall bladder, with low grade abscesses in the liver from staphylococcal infection, an acute inflammatory process in the upper part of the abdomen, either local or part of a generalized infectious or malignant process, a progressive, acute disturbance in the upper part of the abdomen culminating in an acute condition, such as a perforating duodenal ulcer or similar lesion, subdiaphragmatic abscess, perinephritic abscess, and abscess of the liver.

November 22, roentgenograms of the thorax gave evidence of bronchopneumonia involving the base of the right lung. The concentration of sugar in the blood was 150 milligrams in each 100 cubic centimeters. A few days later exploration, under spinal anaesthesia, was advised. Five cubic centimeters of 10 per cent solution of calcium chloride, mixed with 200 cubic centimeters of physiologic solution of sodium chloride, was given intravenously on two successive days before operation. The coagulation time (Boggs) was 8 minutes, 30 seconds, and the bleeding time was 2 minutes, 30 seconds. The urine was normal except for a trace of bile. Repeated

examinations of the blood prior to operation disclosed that the concentration of the hæmoglobin averaged about 38 per cent, that erythrocytes numbered 3,000,000 and leucocytes 14,000 in each cubic millimeter of blood. The van den Bergh reaction was direct, and the concentration of serum bilirubin fluctuated between 1.0 and 5.2 milligrams in each 100 cubic centimeters. During the 14 days before operation the temperature fluctuated from 105 degrees F to normal, and the pulse rate varied from 80 to 130.

November 26, an upper right rectus incision was made. The lower part of the abdomen was found to be normal. Between the liver and the diaphragm from 10 to 15 cubic centimeters of pus was found, which did not seem enough to account for the patient's illness. The hepatic tissue appeared to be in good condition, the edges were feathery, there was no localized swelling or bulging, although the right lobe appeared to be a little fuller than normal. A needle was passed into the right side of the liver for a distance of 7.5 centimeters, and a large pocket of pus was found. A trocar was passed, and about 700 cubic centimeters of greenish yellow, odorless pus was evacuated from the anterior and superior portion of the right lobe of the liver. The index finger was then inserted, but adjacent abscesses were not revealed. A large tube was inserted for drainage, and was stitched to the capsule of the liver. Strips of iodoform gauze were packed around the tube. Further exploration was not done. Culture of material from the abscess cavity, on blood agar and in brain broth, resulted in growths of a green-producing streptococcus. On the first day after operation the wound drained freely around the tube. Irrigations with boric acid were begun the second day, and the boric acid solution was replaced by Dakin's solution on the fourth day. The gauze pack was removed on the tenth day, and the tube was removed on the eleventh day after operation, because the wound was not draining. Each day the patient received intravenous injections of 10 per cent solution of glucose. The temperature remained around 100 to 101 degrees F until the fourth day after operation, when it rose to 104 degrees F and continued to be remittent. The pulse rate averaged about 110.

December 11, the temperature began to rise, the pulse rate varied between 120 and 140, and it was thought that a second abscess was developing. However, the original abscess was not draining well. Therefore, 2 days later forceps were inserted to establish additional drainage of the primary abscess, and 250 cubic centimeters of pus was evacuated. However, the pulse rate continued to fluctuate between 120 and 160 and the temperature between 97 and 105 degrees F. Repeated examinations of the blood disclosed that in spite of several transfusions of 500 cubic centimeters or more of blood, the concentration of hæmoglobin remained at 50 per cent. The number of leucocytes remained stationary at 9,000 in each cubic millimeter of blood.

toneum used as an adjunct to roentgenologic studies may be of value in some cases

PATHOLOGY

Pyogenic abscesses of the liver may be single or multiple. The large single abscess calls for prompt surgical measures. According to Moynihan about 70 per cent are single and affect the right lobe. This may be explained by the fact that the right portal branch is the largest swiftest and most direct route by which infective emboli can gain access to the portal spaces. The left lobe of the liver is affected in only 15 per cent of cases and if it is affected two abscesses are likely to be present within the liver.

Following the implantation and proliferation of bacteria in the portal spaces the abscess begins as phlebitis with occlusion of the smaller portal branches as described by Kaufmann. Necrosis follows rapidly. A surrounding purulent exudative inflammation accompanies the necrosis and the involved mass of hepatic tissue is soon liquefied. The single abscess cavity is large irregular in outline and circumscribed by a thickened fibrous capsule in the chronic form of the disease. The abscess not infrequently remains sterile. At times the abscess may be partially absorbed and the cavity completely obliterated.

DIAGNOSIS

An accurate diagnosis may be very easily attained if one suspects the presence of hepatic abscess from the start. However at best the development of a correct diagnosis is usually a trying affair. The following should be excluded: pyogenic infections elsewhere in the body, malaria, pneumonia, tuberculosis, malignancy, gumma, and hydatid cyst. The diagnosis may be said to be based completely on the history of some recent intra abdominal surgical procedure, remittent fever, enlarged tender liver, and fluoroscopic examination.

REPORT OF CASE

A local infection involving the right lobe of the liver was established by the following facts: The patient had been ill for several months with a remittent fever, enlarged tender liver, and fluoroscopic examination

The patient complained of two distinct types of pain. The gastric history had indicated that the pain was located in the right upper quadrant of the abdomen. The patient had been ill for several months with a remittent fever, enlarged tender liver, and fluoroscopic examination

General examination revealed that the patient had been ill for several months with a remittent fever, enlarged tender liver, and fluoroscopic examination

On physical examination the patient was found to have a right upper quadrant tenderness and a small, firm, nontender mass in the right upper quadrant of the abdomen.

The patient was operated upon and a large abscess was found in the right lobe of the liver. The abscess was drained and the patient recovered.

pads and exploratory aspiration with a good-sized needle follows. After finding an abscess cavity in the anterior and superior portion of the liver, a large Potain aspirator is inserted. This is followed by placing a large rubber tube through the metal cannula. The tube is then sutured to the capsule of the liver and a generous amount of iodoform gauze is placed around the tube to wall off the draining sinus. In a few days the cavity may be irrigated with solution of boric acid. At a later date Dakin's solution may be used. The possible disaster from air embolism rules against the use of hydrogen peroxide as a liquefier. If the puncture wound is sufficiently large to admit the index finger adequate exploration of the cavity should follow. Frequently, partitions of adjoining abscess cavity may be broken down. Should serious hæmorrhage develop, the cavity can be packed. Moynihan's method of suturing the capsule and hepatic substance at the periphery of the abscess cavity to the peritoneal and rectus muscle as a substitute for adhesions which would protect the peritoneal cavity from contamination has not been especially satisfactory.

Transpleural method This procedure has been found satisfactory at times. The operation can be accomplished in one or two stages, depending on the presence of adhesions. Usually the diaphragm is sutured to the parietal pleura, and the abscess cavity is opened 1 or 2 days later, either by means of the scalpel or the actual cautery.

Subpleural method This is the operation of choice. Incision is made along the line of the

ninth rib crossing the anterior axillary line about 5 centimeters above the costal margin. The rib is resected and the diaphragm is incised. Then the abscess is explored. This method is frequently combined with the abdominal method when the hepatic abscess lies high and posteriorly.

Retroperitoneal method This operation is rarely used and seldom indicated.

SUMMARY AND CONCLUSIONS

The occurrence of idiopathic primary hepatic abscess is relatively rare. The etiology usually is obscure. Diagnosis of primary hepatic abscess is seldom made. It should be based on a recent history of some intra-abdominal surgical procedure, remittent fever, the presence of an enlarged tender liver, and positive fluoroscopic evidence. Treatment should aim at free drainage, the method instituted depending on the size and situation of the abscess cavity. The physical signs, symptoms and pathological changes are briefly summarized in this paper. A report of one case is included.

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A rather detailed and complete report of
the single case of hepatic abscess seems justifi-
fiable because of the many interesting features
of the case. The diagnosis was obscured from
the beginning. The changing symptom asso-
ciated with progressive weakness, anemia
and loss of weight aroused the suspicion
of the presence of a malignant condition. The
history that the patient had undergone
operations 3 and 5 years previously seemed to
be of little significance. In spite of repeated
laboratory examinations and clinical obser-
vations a working diagnosis could not be
made and exploratory operation was delayed.
Patients suffering from hepatic abscess as this
patient is are likely to come to operation in
a debilitated state which adds to the high
mortality.

The persistence of chills fever and elevated
pulse rate following adequate drainage indi-
cated that a second abscess might be present.
However as the patient's condition did not
justify further extensive operation additional
exploration was not done. Nevertheless
secondary drainage of small collections of
purulent material beneath the diaphragm was
effected more than once apparently with
improvement.

A diet high in carbohydrates seemed to be
effective in sustaining bodily functions and
promoting hepatic regeneration. Repeated

transfusion of blood was the necessary factor
to allow the patient to go on in spite of the
progressive destructive anemia. Whether or
not the second abscess was present at the
time of operation or followed by direct ex-
tension is of no consequence. Nevertheless
postmortem examination gave adequate ex-
planation of the relatively high mortality in
cases of primary abscess of the liver, namely
the presence of a second abscess and the in-
volvement of the pleura and the peritoneum.

PROGNOSIS

It is generally agreed that the mortality
resulting from pyogenic abscess of the liver
approximates nearly 50 per cent. This does
not seem unlikely for because of delay in
diagnosis the patients frequently come to
operation as poor surgical risks. In addition
the chances of draining adequately more than
one abscess cavity are doubtful. Finally the
promptness with which complications of the
peritoneal and thoracic cavities follow makes
the operative risk especially great.

TREATMENT

Treatment should aim at free and adequate
drainage the method instituted depending on
the size and situation of the abscess.

Although aspiration for diagnosis is and treat-
ment has had its adherents the use of this
procedure should be strictly confined to
amœbic abscesses. Whenever aspiration is
practiced one should be in a position to
explore immediately should an abscess be
present. Repeated aspirations as a therapeutic
measure in cases of hepatic abscess we
feel should be abandoned. Small well encap-
sulated quiescent abscesses are just as likely
to become self limited as they are following
aspirations. Negative results of aspiration
could hardly influence either the indications
for or site of an exploratory procedure.
Instead it has been found more satisfactory
to use the aspirating needle in the course of
the operation. The following methods of oper-
ation have become more or less standardized.

Abdominal or transperitoneal method. A
right rectus incision is made and complete
exploration of the abdominal cavity is carried
out. The liver is then packed off with gauze

pads and exploratory aspiration with a good-sized needle follows. After finding an abscess cavity in the anterior and superior portion of the liver a large Potain aspirator is inserted. This is followed by placing a large rubber tube through the metal cannula. The tube is then sutured to the capsule of the liver and a generous amount of iodoform gauze is placed around the tube to wall off the draining sinus. In a few days the cavity may be irrigated with solution of boric acid. At a later date Dakin's solution may be used. The possible disaster from air embolism rules against the use of hydrogen peroxide as a liquefier. If the puncture wound is sufficiently large to admit the index finger, adequate exploration of the cavity should follow. Frequently partitions of adjoining abscess cavity may be broken down. Should serious hæmorrhage develop the cavity can be packed. Moynihan's method of suturing the capsule and hepatic substance at the periphery of the abscess cavity to the peritoneal and rectus muscle as a substitute for adhesions which would protect the peritoneal cavity from contamination has not been especially satisfactory.

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The occurrence of idiopathic primary hepatic abscess is relatively rare. The etiology usually is obscure. Diagnosis of primary hepatic abscess is seldom made. It should be based on a recent history of some intra-abdominal surgical procedure, remittent fever, the presence of an enlarged, tender liver and positive fluoroscopic evidence. Treatment should aim at free drainage, the method instituted depending on the size and situation of the abscess cavity. The physical signs, symptoms and pathological changes are briefly summarized in this paper. A report of one case is included.

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CLINICAL SURGERY

FROM THE JAMES BUCHANAN BRADY UROLOGICAL INSTITUTE

OBSTRUCTIONS TO THE URETER PRODUCED BY ABERRANT BLOOD VESSELS

A PLASTIC REPAIR WITHOUT LIGATION OF VESSELS OR TRANSPLANTATION OF URETERS

HUGH HAMPTON YOUNG MD FACS B T M

MUCH attention has been directed in recent years to the study of obstructions to the ureter at or near the uteropelvic junction produced by blood vessels or fibrous cord containing blood vessels generally aberrant in character which cross the ureter in passing from the great blood vessels to the lower pole of the kidney. While there is still no definite agreement as to the inception of these cases the consensus of opinion is that operative relief of some sort is necessary in order to prevent a further development of the hydronephrotic condition with ultimate destruction of the kidney. Although in some cases the dilatation of the pelvis and calyces may progress slowly and after several years not reach a stage in many other cases the progress of the hydronephrosis is much more rapid and leads quickly to the formation of huge sacs with great thinning of the renal cortex and destruction of the renal function. With the onset of a serious pathological condition with grave renal impairment the history of these cases usually exhibits definite symptoms of pain distal to the characteristically both kidney region with the

ultimate development of systemic symptoms as the disease progresses. In some cases the symptoms may remain slight although the hydronephrotic condition may be great. The condition may be suspected when a young patient with the evidence of injury or pathological condition of the urinary panto comes on insidiously in the renal region. In one of our recent cases the symptoms were so slight that attention was hardly directed at all to the kidney but an experimental intravenous urogram revealed a considerable dilatation of the pelvis and calyces. In the detection of this condition intravenous urography is of great value but in order to detect roentgenologically the obstruction and block of the ureter due to a vascular condition retrograde urography is essential.

After the discovery of unilateral or bilateral hydronephrosis either producing symptoms or not one must consider the importance of investigation and relief in order to avoid ultimate destruction of the kidney substance serious complications due to secondary infection. When both kidneys are hydrophrotic distention must be made a task which should be attacked first as will



Fig. Roentgenogram Case

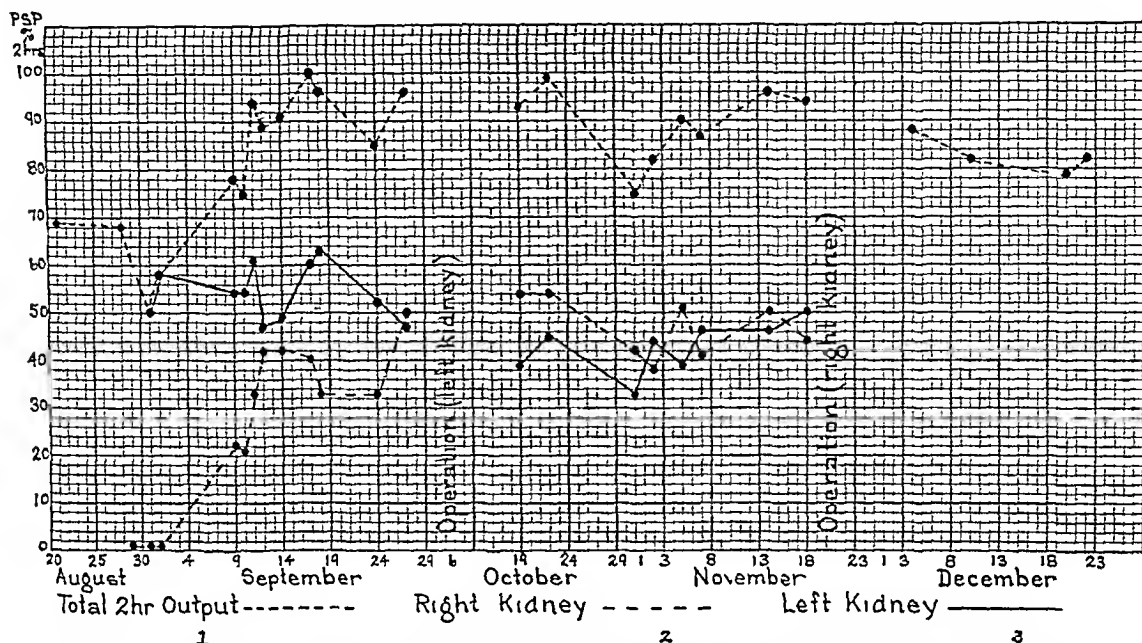


Fig 2 B U I 1905 Showing the changes in renal function as a result (1) of continuous ureteral catheter drainage of the right kidney during August and September, (2) during the period after operation upon the left kidney, October, November, (3) after plastic operation upon right kidney (December)

be shown in the first case reported here. Having decided that intervention is necessary for the hydronephrotic condition, it is important at operation that one should proceed cautiously, so as to obtain a complete study of the conditions present at the ureteropelvic juncture, in order that accurate information as to the cause of the hydronephrosis may be determined. By proceeding carefully and demonstrating that the dilatation of the pelvis and calyces is due to aberrant vessels or vascular bands which cross the ureter at or near the pelvic juncture, thus producing compression, kinking, stricture or valve-like conditions which are responsible for the obstruction to free outflow of urine from the pelvis, the operator must determine what means should be adopted to relieve the condition.

During the past 15 years, numerous papers have appeared advising the removal of the obstruction to the ureter by division and ligature of the blood vessels. More recently, however, it has been pointed out that such destruction of vascular supply of the lower pole of the kidney often leads to definite impairment of the organ, and sometimes to pronounced atrophy or even necrosis. On this account Quinby and others have advised that instead of division and ligature of the vessels, the ureter should be cut off and transplanted to another portion of the kidney where good drainage

and freedom from vascular compression in the future may be obtained. Such a procedure has apparently not always been successful, and cases in which nephrectomy became necessary are recorded in the literature. Whereas simple removal of the vascular obstruction or transplantation of the ureter was for a time considered sufficient in most cases, the recent trend has been toward resection of the markedly redundant renal pelvis in order to remove permanently the hydronephrotic sac after the obstruction has been removed. But the impairment or serious injury to the kidney produced by ligating the vessels to the lower pole, and the occasionally very imperfect results obtained by ureteral transplantation have brought forcibly to my attention the fact that both these procedures are far from ideal. For some time I have been considering whether it would not be possible by a plastic procedure, while carrying out resection of the dilated pelvis, to separate the vessels and ureter so that the obstruction would be removed, and all chance of future recurrence eliminated. I am glad to report herewith two cases in which it has been shown conclusively that such is possible. As will be described in detail further on, no difficulty was experienced in carrying out resection of the anterior and posterior aspects of the redundant pelvis, and in so closing by sutures the defect thus produced that the vessels and ureter

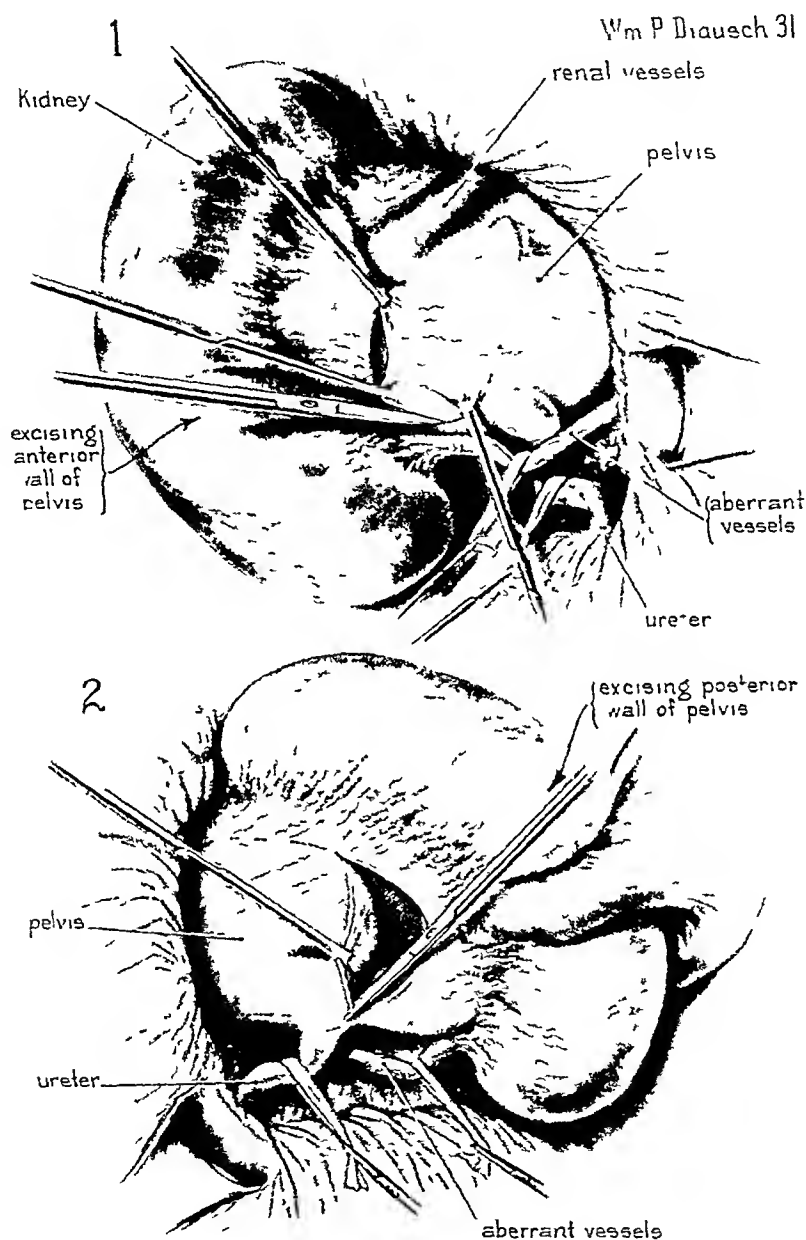


Fig 5 The new plastic operation to reduce size of pelvis and also to separate ureter and veins from each other 1, Resection of portion of anterior surface of pelvis, 2, resection of portion of posterior surface of pelvis

was necessary to change the catheter by cystoscopy at periods varying from a few days to a week or more, depending on the accumulation of pus, and the blocking of the catheter which could be relieved by irrigation and suction. Satisfactory

drainage was maintained for several weeks and with remarkable results. At the end of a week a small amount of phthalein was obtained from the supposedly completely destroyed right kidney. At the end of 18 days 22 per cent was eliminated in 2



Fig 6. t mplyed t t th pl w d
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hours and at the end of a month the function from this side was 48 per cent almost as good as the other kidney which had previously been doing all the work. The demonstration of the great value of an indwelling ureteral catheter with drainage continuing for many weeks was apparently new as the demonstration that such a kidney after years of obstruction and formation of a hydronephrotic sac could be restored almost to normal function. As a result of these lesions it was decided that the kidney should be preserved and nephrectomy was decided it was thought advisable to operate at first upon the least damaged side and when this kidney was exposed it clearly showed that the obstruction was due to a fibrous cord containing artery and vein which ran from the great vessels to the lower pole of the kidney

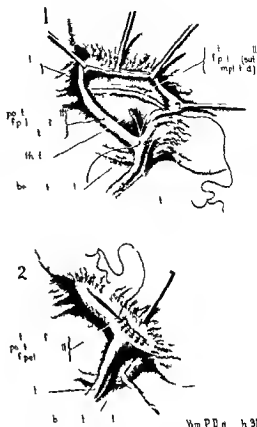


Fig 7. Cl f th w und ft f th
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but a compression of these vessels seemed to produce only a little change in the vascularity of the lower pole. The operator decided simply to clamp, divide and ligate the vessel. This completely removed the obstruction and the kinking of the ureter and inspection of the interior of the pelvis showed that the drainage was satisfactory. During the next few days following the operation the diminished phallic tests showed a further reduction in function in the kidney as a result of the ligation of the vessel is going to the lower pole. In fact for a time the function from the opposite side which had a great hydrocephalic sac was present although originally it had no function was greater than that of the kidney

Wm P Didusch 1931

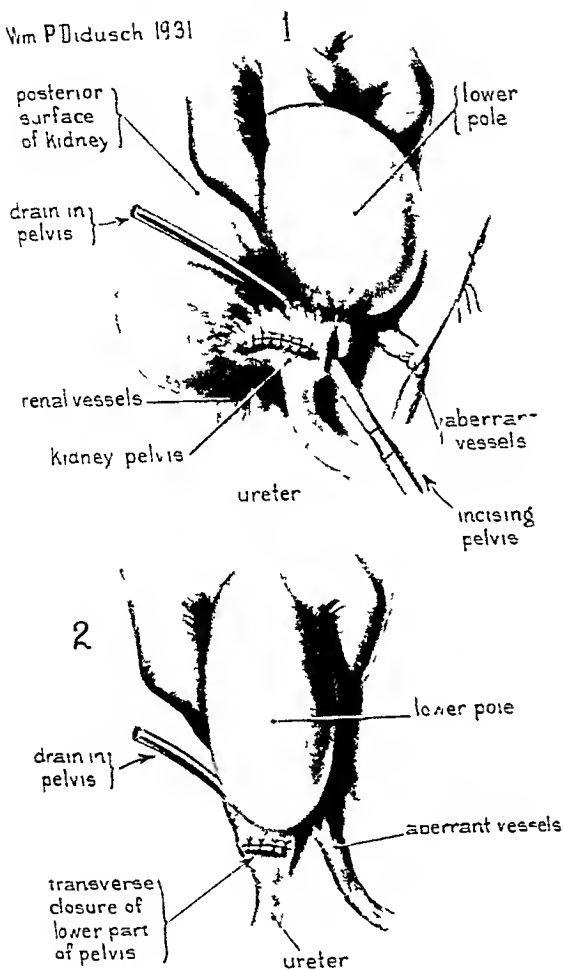


Fig 8 Additional incision closed by Heinecke Mikulicz principle employed to bring orifice of ureter nearer lower pole and farther away from veins. Catheter draining pelvis and ureter which was brought out through the skin wound shown

which on admission was doing all the work. This finding fortified me in my decision to attempt a plastic upon the other renal pelvis by means of which the ureter might be separated from the veins without operating on either. As remarked above, this was carried out in this case, and then in another with apparently perfect success, as will be shown in the details of the 2 cases which now follow

CASE I. Bilateral hydronephrosis due to obstruction at the ureteropelvic juncture by aberrant vessels running to lower pole of kidney. Moderate hydronephrosis, left side, with no renal impairment and no infection. Huge hydro-

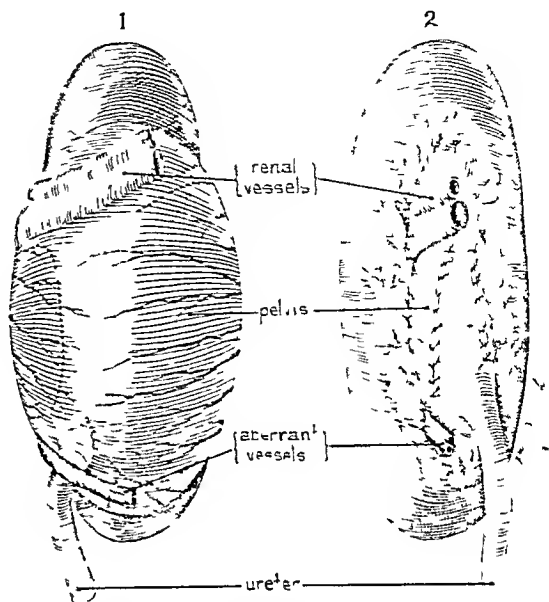


Fig 9 Drawing to indicate extent of resection. Closure of wounds and separation of ureter from veins

nephrotic sac, right side, with severe infection, and apparently complete impairment of kidney function. Remarkable recovery of function by continuous drainage for a month with inlying ureteral catheter. Operations on both sides, vessels obstructing ureter ligated and divided on the left side with subsequent impairment of renal function. A new plastic procedure devised and carried out on right side by means of which we succeeded in avoiding operation upon either vessels or ureter, and succeeded in widely separating the two. Complete relief of hydronephrotic sac on both sides as shown by subsequent urograms.

I A G, B U I 19005, male aged 10 years, was admitted to the Brady Urological Institute August 19, 1930, complaining of "cystic kidneys". The family history was negative. The patient had, in childhood, measles, varicella, pertussis, mumps, dengue fever, tonsillitis, adenoids, and at the age of 17 (2 years ago) scarlet fever. Tonsillectomy was done in 1910. He was frequently constipated, and occasionally had clay colored stools, was never jaundiced. There was no venereal history. General health had never been good, had always been considered weak, puny, and underweight. In May, 1928, patient had an attack of scarlet fever, after which urine contained albumin, which became greatly decreased while the patient was in the reclining posture. A diagnosis of orthostatic albuminuria was made. In July, 1929, there was considerable swelling beneath the ribs in the right half of the abdomen. This was associated with a sense of pressure, but there was no pain, nausea or vomiting, or other genito-urinary or gastrointestinal symptoms. There were no chills or fever. Heat was applied and after a few days the swelling disappeared. An X ray was obtained, and a tentative diagnosis of enlarged gall bladder was made. After this the swelling recurred about every 6 weeks, lasting each time several days, but unassociated with any local or constitutional symptoms.

In April, 1930, the patient's physician decided that a laparotomy should be carried out on account of the supposed greatly distended gall bladder. An incision was made



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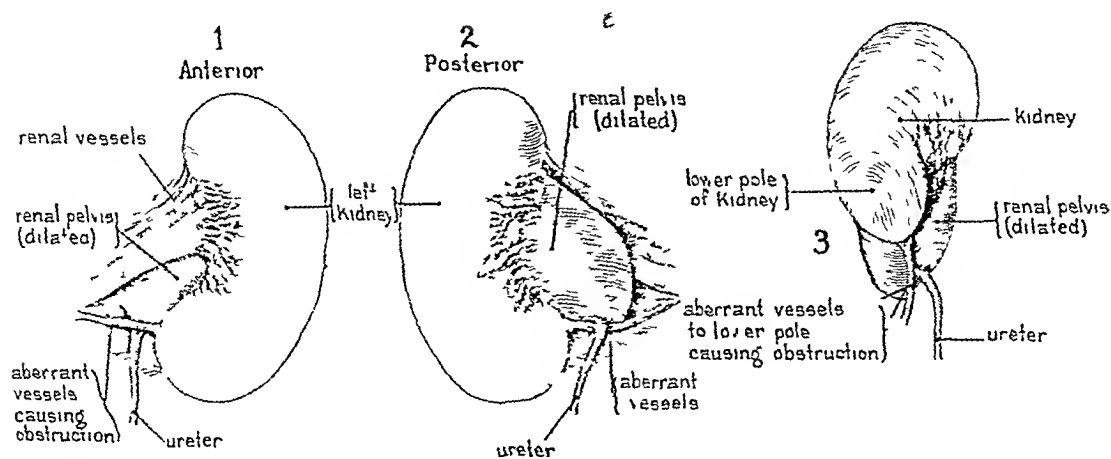


Fig 11 Anterior and posterior surface of kidney and lower pole in Case No 2, showing aberrant vessels to lower pole and the resultant kinking and obstruction of the ureter

total of 32 per cent being excreted for $\frac{1}{2}$ hour. The amount of urine obtained from left side in $\frac{1}{2}$ hour was 30 cubic centimeters. No phthalein was obtained transvesically. The capacity of the hydronephrosis on the right side was 1,000 cubic centimeters, on the left side, 150 cubic centimeters. The left pyelogram revealed hydronephrosis of the kidney pelvis, only about one third size of the right.

Bilateral retrograde pyelograms were done with 12½ percent sodium iodide. As seen in Figure 1, 1 and 2, both kidneys were markedly hydronephrotic. The left kidney pelvis was the smaller of the two, was somewhat pear shaped, and measured $3\frac{1}{2}$ by 3 inches. The most interesting feature was marked kinking and obstruction in the ureter just at the ureteropelvic juncture. The ureter was seen here to be compressed (no shadowgraphic fluid was shown at this point), was directed outward and pronouncedly kinked as it entered the pelvis. (At operation it was shown that this was produced by a fibrous band containing artery and vein, which ran from the great vessels to the lower pole of the kidney, thus producing compression and kinking of the ureter.) The kidney cortex was somewhat thin.

On the right side the pelvis was greatly dilated, measuring $6\frac{1}{2}$ by $4\frac{1}{2}$ inches. The ureteral catheter was seen to pass upward over the front of this dilated pelvis. The ureteropelvic juncture was not seen. The kidney cortex was greatly thinned.

Following this cystoscopy the left ureteral catheter was removed. A catheter was left in the right ureter continuously, to drain the huge hydronephrosis. After the patient was returned to the ward, a purulent, greenish fluid continuously flowed from the pelvis. There was so much thick pus present that the catheter frequently became plugged and required aspiration.

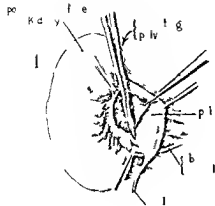
August 31, differential phthalein. The urine from the left side was obtained transvesically. No phthalein was obtained in 2 hours from the right side. On the left side, the appearance time was 7 minutes, and half hour readings showed 15, 15, 10, and 10 per cent. A total of 50 per cent being obtained in 2 hours. The ureteral catheter was left to drain the right kidney. The drainage from the right kidney was occasionally unsatisfactory because of the thick mucopus.

September 5, the right ureteral catheter, which had been in place 7 days, was removed. Cystoscopy was

carried out. A Garceau catheter, which was inserted to the kidney, showed that the pelvis was practically empty, thus indicating satisfactory drainage. With the Garceau catheter inserted only 8 centimeters into the left ureter, 125 cubic centimeters of 12½ per cent sodium iodide was introduced, and a pyelogram obtained. This showed the same picture as in the previous film, except that the ureter was filled. This examination was also made with patient in upright position, and no ptosis was revealed.

The right Garceau catheter was replaced by a No 7 catheter introduced up to the kidney pelvis and left in place for drainage. Four days later, the drainage having been very satisfactory, a phthalein test showed for the first time the presence of phthalein coming through the catheter draining the right kidney. The fluid excreted in 2 hours from the right side amounted to 710 cubic centimeters, from the left side, 550 cubic centimeters.

On September 9, the right kidney had been more or less continuously drained by an indwelling ureteral catheter for 19 days and during this time a remarkable transformation in the renal function of the right kidney had occurred, as previously stated. The phthalein, which had previously been only a trace, improved wonderfully and had reached 22 per cent in 2 hours from this kidney, which on admission 2 weeks before had 1,000 cubic centimeters fluid removed from it and at operation several months previously 4,000 cubic centimeters were said to have been removed. An interesting chart prepared by Dr S A Vest (Fig 2) shows the amazingly rapid improvement which occurred in the right kidney, which had been drained continuously with the catheter. As seen here, during the next 5 days, the phthalein obtained from the right kidney rapidly mounted from 22 to 42 per cent in 2 hours. At the same time the appearance time dropped from 12 minutes to 7 minutes, and the amount excreted during the first half hour increased from 10 to 20 per cent. During the next 2 weeks the improvement of phthalein on the right side was maintained, the reading on September 27 being 50 per cent in 2 hours whereas on the left side the phthalein remained constant between 52 and 63 per cent. During the first 6 weeks after entrance, the condition of the patient remained about the same. He ran at times a temperature which twice reached 102 degrees, and pulse of 120. These occurrences generally coincided with the plugging of the ureteral catheter, and were accompanied by some pain and symptoms of



2

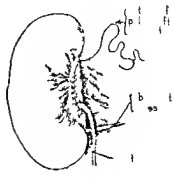


Fig. 1. g. pl. t. p. t. t. m. t. f. m. p. n. t. f. Th. ect. by
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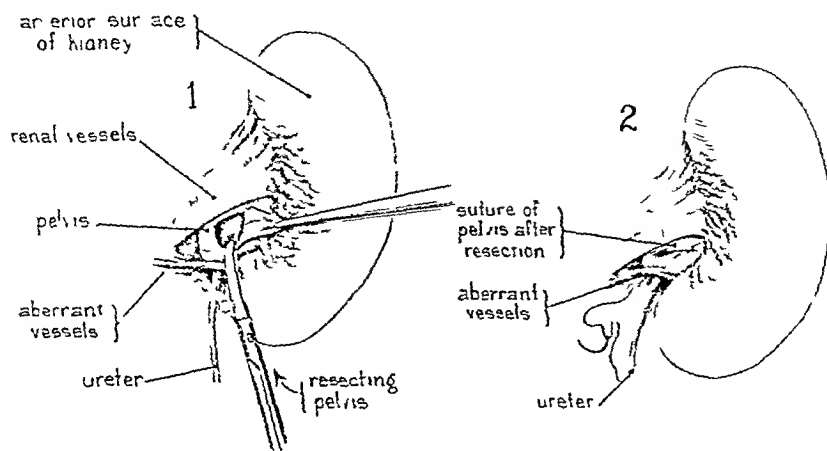


Fig 13 Anterior surface of kidney showing resection as carried out, and suture transversely to draw vessels upward and away from the proximity of the ureter. In this way the ureter and veins were widely separated from each other and all chance of obstruction in the future is removed.

On October 19 (13 days after operation) phthalein estimations were made. From the right side the 2 hour total was 54 per cent, but from the left side (operated upon, veins to the lower pole ligated), only 39 per cent was obtained, as shown in the chart prepared by Vest (Fig 2). As shown here the left kidney, impaired by operation, gradually improved in function, and the right kidney maintained its previously good function, often equaling that of the left side. During this entire period of 1 month, ureteral catheterization of the right renal pelvis was maintained, the catheter being changed only once during these 4 weeks. During this time the temperature remained normal, the pulse averaged 90, and the condition of the patient was excellent. The blood urea varied from 24 to 32. At this time the patient was considered sufficiently improved for operation upon the huge hydronephrosis on the right side. On November 13, another right pyelogram was done, with 500 cubic centimeters of fluid, 12½ per cent sodium iodide, and showed a huge hydronephrosis due, apparently, to a stricture at the ureteropelvic juncture.

Operation was done November 19, 1930, by Young, under gas anesthesia. Extraperitoneal exposure of the right kidney pelvis, and ureter. Discovery of huge hydronephrosis, aberrant vessels to lower pole, causing kink in ureter just below ureteropelvic juncture. Kidney greatly thinned and enlarged, lobulated. Resection of large part of anterior wall of pelvis with plastic to draw blood vessels compressing ureter upward and forward. Similar resection of posterior wall of pelvis with plastic to draw ureter upward and backward away from veins. Completely successful. Ureter and pelvis drained through small stab wound in posterior surface of pelvis brought out to upper angle of skin wound. Kidney replaced in proper position. Wounds closed with catgut and silk. Condition of patient excellent.

The kidney was exposed through a long curved incision back of the previous operative scar. It was easily reached and found to have pronounced adhesions along lower border and over lower portion of the pelvis. The kidney was much longer than usual, but its renal substance felt firm and fairly good, the cortex not being markedly thin. The pelvis was very greatly dilated in the form of a huge sac, with the ureter kinked by a large cord of blood vessels which ran to

the lower pole, as is graphically shown in Figure 3, made at the time of operation. As seen here, the ureter was definitely enlarged and thickened. It passed up along the anterior surface of a greatly dilated pelvis, which hung far below but extended well over toward the midline, smaller than shown in the pyelogram (the result of prolonged drainage). As seen in Figure 4, an artery and vein forming part of a fibrous cord ran from the great vessels across the lower anterior part of the pelvis across the front of the ureter to the lower pole of the kidney. The ureter was compressed and kinked by the vascular cord. The ureter was dilated somewhat above the constricting vessels, and was thickened below the point of compression by the vessels. The ureter was freed for a distance of 4 to 5 inches, and no adhesions or anything suggesting stricture were found. An incision was made in the anterior surface of the pelvis in order to allow a view of the ureteral orifice. It was found to be ring like, fairly thick and apparently muscular. A good view was obtained, and apparently no stricture or valve was present, as it was possible to pass a fairly large clamp into the ureter by the side of the ureteral catheter which he had been and was still wearing. The interior of the pelvis was rough, strawberry-like, and thick pus was present. The operator then considered a plan which he had previously thought of, of carrying out resection and a plastic in front and behind, with the idea of carrying the ureter backward and upward, and the veins forward and upward so as to separate the two as widely as possible, and prevent further compression of the ureter by the veins. If this could be successfully carried out, it would do away with the necessity of dividing and ligating the veins or of dividing and transplanting the ureter, and at the same time the pelvis would be reduced to proper size. After careful investigation it was found possible to carry this out without difficulty. The operation is shown very graphically in the drawings by Mr. Didusch made at the time. As seen here, a somewhat elliptical area of the anterior wall of the dilated pelvis was excised (Fig 5, 1). A larger area of the posterior wall of the dilated pelvis was then excised (Fig 5, 2). The pelvis was then closed anteriorly with chromic catgut so as to draw that portion of the pelvis to which the vascular cord was adherent upward and inward (see Fig 6). The

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 m th r a p y A p t r y m t
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 t o c d m y G r a m g t b a l l Th w d
 h f d f l y s a t f r i l y d m p l t l y l s e d
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 (Fig 3) a d h w d r y d f t l y t h t h d t d
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 d e r a b l y l g d d t h m j d m u l y
 d e b l y d i l t e d f r m g l b l t e d h d w w h h
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cortex measuring from $\frac{1}{2}$ to 1 inch. There is no extrarenal dilatation of the pelvis. The major and minor calyces still show an irregular dilatation, but this has become distinctly smaller since discharge from the hospital, and now measures about 10 by 3 centimeters. The ureter on both sides is negative.

August 19, 1931, patient returned for examination. He has been carrying on active university work and plays one or two sets of tennis a day. He has very slight left kidney pain when riding in an automobile. He has gained 10 pounds in weight. Forty grams of iopax was injected intravenously and films taken 15, 25, 35, and 90 minutes after injection showed considerable diminution in size of the calyces on the right side. The kidney pelvis was not visualized. On the left side the kidney pelvis remained small and contracted. Cystoscopy was done, with bilateral catheterization. No 7 catheters passed into the pelvis of each kidney without difficulty. Twenty cubic centimeters of urine drained from the right catheter in 5 minutes, 10 cubic centimeters from the left ureter in 3 minutes. Specimens from each kidney were sterile. Phthalein test showed left appearance time, $2\frac{1}{2}$ minutes, first half hour 125 cubic centimeters, 25 per cent, second half hour 25 cubic centimeters, 10 per cent, total 1 hour, 35 per cent, right, appearance time $3\frac{1}{2}$ minutes, first half hour 110 cubic centimeters, 10 per cent, second half hour 100 cubic centimeters, 10 per cent, total 1 hour, 20 per cent transvesical phthalein 1 hour 2 per cent, total phthalein output 1 hour, 57 per cent. Bilateral pyelography carried out with iopax showed the following. The kidney calyces and pelves were visualized on both sides but no shadows at the ureteropelvic junctions were obtained. The ureters below this point were not dilated.

CASE 2. Unilateral hydronephrosis due to obstruction at the ureteropelvic junction by aberrant vessels to lower pole of kidney. Use of same plastic procedure to avoid injury of either vessels or ureter, and to separate them widely. Complete success, as shown by subsequent urograms.

H. B., B. U. I. 20430, male, aged 14 years, was admitted February 17, 1931, complaining of pain in the left side, of 8 months duration. Patient has had chicken pox, measles, pertussis and swollen glands. Tonsillectomy was done at the age of 3 years with excellent results. The past history was otherwise negative. Patient has always enjoyed good health. Eight months ago, immediately after the boy had turned a somersault, he noticed a fairly severe, acute pain in the left flank beneath the ribs. He ate dinner, and 2 or 3 hours later, the pain became quite severe, and nausea came on. The pain continued for about 24 hours, gradually getting less and then disappearing. The pain did not radiate, it was not associated with hæmaturia, and the patient passed no calculus. There was no pain in the opposite side, and micturition was normal. No physician was consulted, and no morphia was given. After that the patient was free from pain and discomfort for a month. He then had a second attack of pain similar to the first (but it did not follow athletic exercise). This attack was also associated with nausea and vomiting. It again lasted for about 24 hours. After that the patient had similar attacks about once a month, but during the last month he has had four attacks, two within the past week, and during these the patient found that if he made pressure on the left side the pain became very severe in intensity and knife-like in character. The pain was always localized to the left costovertebral angle and beneath the ribs on the left side. It never radiated, and was never associated with any abnormality of micturition, or with chills or fever. His general health remained good.

Six days before admission the patient was examined in the medical dispensary of the Johns Hopkins Hospital.

The only positive finding was a spina bifida. The urine was reported normal. The patient was then referred to the Department of Neurology to see whether the spina bifida could account for the pain, and the report received was "examination negative in neurology." On the next day the patient came to the out-patient urological dispensary where again the physical examination and urinalyses were negative. Neither kidney was palpable or tender. As the pain suggested something renal, the patient was sent to the Brady Urological Institute, where an intravenous injection of iopax, 40 grams, was given. X-ray films were taken 5, 15, 30, and 45 minutes later and showed a large hydronephrotic left kidney with evident obstruction at the ureteropelvic junction (Fig. 10, 1). The right kidney was apparently normal. The bladder was normal.

The patient was then admitted to the hospital. At that time he gave no symptoms. The last attack of pain was 3 to 4 days before, again associated with nausea and vomiting, not radiating, and with no urinary symptoms.

Examination revealed an apparently normal, but somewhat undersized, boy. The chest was negative. The abdomen was symmetrical, no enlargement was visible. There was no rigidity of the abdominal muscles, no abnormality of organs, no masses were felt, no tenderness, and no muscle spasm was produced by the examination. Although the iopax had shown marked hydronephrosis on the left side, it was impossible to feel the kidney. No tenderness was elicited. The region of bladder, genitalia, rectum, and prostate was negative. Urinalysis disclosed the urine to be acid, specific gravity 1010, no sugar, no albumin, no casts, no white blood cells, no red blood cells, no bacteria, and microscopically negative. Phthalein test showed appearance time, 5 minutes, $\frac{1}{2}$ hour readings, 45, 15, 15 and 10 per cent. The output at end of 2 hours was 85 per cent. Cultures from urine were negative. The blood urea was 32 milligrams per 100 cubic centimeters. Blood pressure was 112-75.

Cystoscopic examination was made. The cystoscope entered easily. The bladder was found to be normal and the ureteral orifices normal. Urine from the right side was slightly cloudy (traumatic). Phthalein appeared in 4 minutes and output was 32 per cent. Urine from the left side was clear and phthalein appeared in 12 minutes trace ("15 per cent"). A retrograde pyeloureterogram was made after $12\frac{1}{2}$ per cent sodium iodide was injected and confirmed the findings obtained by intravenous iopax injections. The catheter passed up to the ureteropelvic junction, but apparently did not enter the pelvis. Although hydraulic pressure was used in filling the ureter, very little of the fluid went into the pelvis. This was probably due to obstruction at the ureteropelvic junction. Most of the sodium iodide flowed back into the bladder, as shown in Figure 10, 2. As seen here the pelvis and calyces are not filled, but at the ureteropelvic junction there is a pronounced kink and compression of the ureter. (At operation this was proved to be a cord that contained artery and vein which ran from the great vessels to the lower pole of the kidney.)

Cultures were reported sterile.

After reviewing the history of the patient and studying the X-ray films, it seemed evident that there was a left side hydronephrosis, apparently caused by an obstruction at the ureteropelvic junction. The etiology seemed uncertain, as the pain began 9 months ago, following a somersault. The attacks were becoming more frequent, more intensely painful, and being accompanied by nausea and vomiting, were, in our opinion, sufficiently severe to warrant operative intervention.

On February 25, 1931, operation was done by H. C. Smith. Ether anesthesia was used. Exploration of left

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CONCLUSIONS

Obstruction at or near the ureteropelvic j c
ture is not infrequently caused by s els which
run f om the great vessels to the lo er p le of the
k dney Two cases are repo ted in which these
vessels caused an acute flexure kinking and ob
structi n of the urete n one case bilateral and
in the other unilateral In the bilateral case the
less affected kidney as operated on fi t and the
aberrant vessels obstructing the ureter were
clamped divided and l gated This was followed
by a dist net postoperat ereduction in the kidney
function on this side At the second operation I
carried out a new p ocedure (a plast c opera
tion) by me ns of hich it was possible not only
to resect the v y redundant pel c sac b t also in
closing it to d aw the ureter away f om the veins
so as to compl tely remove all poss b lity of ob
struct n Th esult obtained in this case was
completely s t factory The same pr c d re was
carried out in the se nd case also with complete
success In the first ca e d a nage of a huge hy
dronephrotic sac was kept p fo over a month by
mean of a retained ureteral theter passing out
through the pemle meatus This resulted in a
ama ng resto tion of this kidney which as
prev o sly funct onle to p actically normal
fu ct so that it was possible t save this
kidney and to carry out the co ervat e plastic
of the pelvis with e cellent res lts

FROM THE SURGICAL DEPARTMENT, MICHAEL REESE HOSPITAL

THE TREATMENT OF ACUTE EMPYEMA

RALPH BOERNE BETTMAN, M.D., F.A.C.S., CHICAGO

THE objectives in the treatment of acute empyema are (1) the removal of pus, (2) the sterilization of the pleural cavity, and (3) the re-expansion of the lung.

In these fundamentals the treatment of an infection of the pleural cavity does not differ at all from that of an infection in bone or for that matter in almost any other tissue. The by-products of the infection, that is the pus, must be removed, the site of infection must become sterilized, and finally the defect due to tissue destruction must be obliterated.

In the case of an empyema, the empyema contents are easily removed by any one of many operative procedures, the sterilization of the pleural cavity is brought about chiefly through nature itself, the obliteration of the infected cavity through the re-expansion of the lung.

The fact that in empyema a very large non-collapsible cavity must be obliterated differentiates the infection of the pleura from infection in other parts of the body.

The rising of the diaphragm, the pulling together of the ribs, and the thickening of the pleura account for only a very minimal part of the obliteration of the cavity. Until the lung re-expands sufficiently to fill the pleural cavity, the infection usually remains. This re-expansion of the lung is without doubt the most important factor in determining the final recovery of an acute empyema.

It is obvious that any method of treatment which facilitates the re-expansion of the lung reduces the period of morbidity, while any method of treatment which allows the lung to remain collapsed lengthens the morbidity. The lung, as we all know, is an elastic structure which tends to collapse and is held to its expanded size by the negative pressure in the chest. We know that once the pleural cavity is opened and air is allowed to rush in, the natural elasticity of the lung will exert itself and the lung will collapse. In the case of an empyema, the lung has already partially collapsed because the purulent products of the empyema have taken up some of the space it formerly occupied. It stands to reason, therefore, that a method of attack upon acute empyema which not only will remove the pus from the pleural cavity and allow the pleura to sterilize itself or

perhaps even aid in the sterilization, but will hasten the process of re-expansion of the lung, is the ideal procedure. By the so called "closed method" of treatment, these three desiderata are attained.

THE PHYSIOLOGICAL REASONS FOR THE CLOSED METHOD

There are several physiological reasons why the closed method of treatment is preferable to the open method. As we said before, the lung is naturally contractile and the only thing which keeps it expanded to occupy the pleural space is the negative pressure within the chest cavity. As soon as an opening is made into the chest wall, air can rush in and allow the lung to collapse. Contrary to long established opinion, the mediastinum is a very flexible structure. It is, therefore, easily pulled over to the opposite side, thus allowing the opposite lung also to contract. Therefore, the first result following an open pneumothorax is a decrease in the volume of both lungs which in turn means a decrease in the amount of air which the lungs contain. As we know, a patient who is sick and has a fever has an increased metabolism, that is, uses more oxygen and, therefore, it is obvious that a decrease in vital capacity is diametrically opposed to his requirements. Furthermore, in the great majority of cases of empyema, the vital capacity of the patient is already diminished by the presence of exudates in the alveoli. Any further reduction in vital capacity might be harmful even in the absence of an increased oxygen need. In the presence of an open pneumothorax, there is a great deal of to and fro motion of the mediastinum because with each inspiration it is sucked over to the good (closed) side of the chest as air enters through the thoracotomy wound and with each expiratory effort it is forced toward the wounded (open) side as the good lung becomes compressed. (Expiration in the presence of an open pneumothorax of any extent ceases to become a passive phase and becomes an active effort.) This to and fro swinging of the mediastinum causes a great deal of shock. An open pneumothorax permits a very speedy evacuation of the pleural cavity with an abrupt change in the intrapleural pressure. Such quick changes are frequently dangerous.

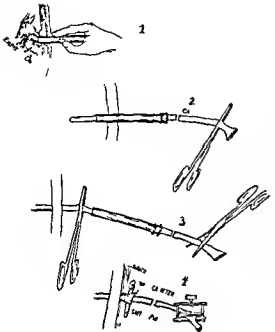


Fig. Method of draining an empyema. Modified method of Cl. 93

As we said in the first paragraph the empyema is finally healed when the empyema cavity becomes obliterated. Any procedure which allows the lung to collapse more than a few days naturally lengthens the morbidity. In the closed method of drainage the lung is actually sucked out for each cubic centimeter of pus which is aspirated an equivalent expansion of the lung must occur to take its place.

The closed method of draining an empyema is the most physiological inasmuch as it disturbs least the mechanism of respiration and is the most ideal from the point of view of shortening the disease inasmuch as it actually aids in the re-expansion of the collapsed lung.

WHEN TO START TREATMENT

There are certain objections to starting the treatment of empyema too early. In the first place it must be emphasized that the presence of fluid even an apparently infected fluid in the pleural cavity during the course of a pneumonia does not constitute an empyema from the point of view of therapeutics. At some time during almost every case of pneumonia there is an increase in pleural fluid. This fluid may frequently be turbid, usually contains pus cells, and very

frequently when cultured will reveal the presence of living organisms. In the majority of cases of pneumonia the presence of this fluid is never discovered and the fluid itself absorbs without any untoward results. Obviously no treatment other than the pneumonia treatment is required. Occasionally this fluid may increase to such an extent that the pressure on the mediastinum and on the heart causes respiratory and cardiac embarrassments. In this case sufficient fluid and only sufficient fluid should be aspirated to relieve the embarrassment.

It is probable that the increase of pleural fluid during pneumonia is a natural protective reaction of the pleura and the lung lying directly under being thus protected from friction. A further reason for occupying part of the pleural space the lung is allowed to contract and therefore become partially immobilized. It is just as beneficial for infected lung tissue to remain quiet as it is for infected tissue in any part of the body.

Therefore one of the chief axioms in the treatment of empyema might be:

Delay treatment if possible until such time as the infection in the lung (pneumonia) has subsided.

It is frequently very difficult to decide exactly when the pneumonia has disappeared and the empyema has become responsible for the patient's symptoms. In cases in which the pneumonia terminates by crisis and in which a period of several days of improvement follows before the empyema symptom arises the question is an easy one. But in cases in which the symptoms of the pneumonia seem to be prolonged into the symptoms evidently produced by the empyema the question is not so easy. Delirium, percussion can be caused by a serous fluid as well as a purulent one. Pressure on the lung from the fluid can produce bronchial breathing. Moist rales will remain long after the pneumonia has subsided. As a rule a patient coughs more after the pneumonia and stays improved during the early course of the empyema. Generally the respiratory rate in the early weeks of the empyema is slower than in the pneumonia although increases in which a large amount of fluid is present this may not be true. The only reliable presence of even small amounts of fluid but a large fluid accumulation may completely conceal it. If the pneumonia is consolidated probably the best single sign which will aid us is the temperature. The temperature of a pneumonia is an irregular temperature but usually a sustained temperature which never reaches normal. The temperature in an empyema is usually a well defined septic

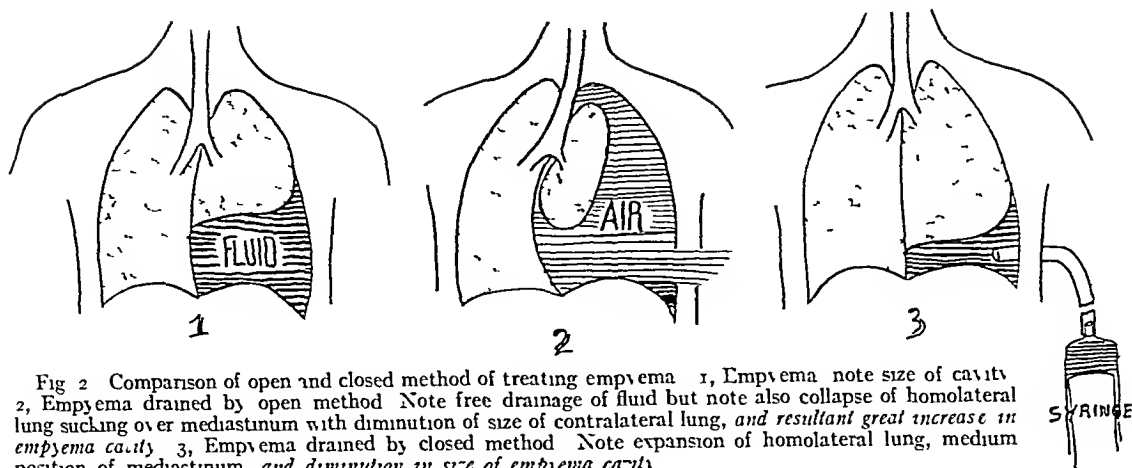


Fig 2 Comparison of open and closed method of treating empyema 1, Empyema note size of cavity 2, Empyema drained by open method Note free drainage of fluid but note also collapse of homolateral lung sucking over mediastinum with diminution of size of contralateral lung, and resultant great increase in empyema cavity 3, Empyema drained by closed method Note expansion of homolateral lung, medium position of mediastinum, and diminution in size of empyema cavity

temperature coming down to normal or nearly normal once a day, usually in the morning and reaching a high point usually in the later afternoon or evening. Of all the signs, the septic temperature is probably the one that is most indicative that the empyema is now the important factor. The actual appearance of the fluid is helpful. For many years it has been known that in cases in which the empyema contents were a frank thick pus the prognosis was favorable. This was due to several reasons, one of them being that by the time the fluid had reached this stage, the pneumonia was sure to have subsided.

WHERE TO DRAIN

In general terms drainage should be at a dependent portion of the empyema cavity. Naturally in cases of encapsulated empyema the site of drainage must be at the site of encapsulation. If the encapsulation is in front, drainage must be through the anterior chest wall, if on the side, lateral, and in back, posterior. The majority of empyemas involve a large area of the pleural cavity extending from the diaphragm upward toward or to the apex and reaching from the vertebral column laterally to or past the anterior axillary line. In such cases it is often a question where the most dependent portion of the pleural cavity is located. Innumerable sites of election for drainage have been advocated. The truth of the matter is that the most dependent portion of the pleural cavity varies with every motion of the patient, with every position that the patient assumes, whether lying or sitting or reclining. With a patient flat on his back, the most dependent portion of the pleural cavity is probably in the seventh, eighth, or ninth interspace in the paravertebral gutter. With the patient semi-reclining,

the dependent portion drops down to the diaphragm. With the patient lying on the infected side, as patients usually prefer to do in the early stages of empyema, the dependent point moves laterally into the axillary region. It is thus obvious that other factors must guide us in our selection of the site of drainage. It is unwise to drain too low because, as the fluid is drained from the pleural cavity, the diaphragm, which is usually partially paralyzed by the inflammation of its pleura, rises and therefore obstructs the site of drainage. It is best not to drain in the very posterior portion, because if the patient lies on his back, the drainage tube may be uncomfortable and also may be compressed by the weight of the patient.

I usually prefer draining somewhere in the eighth or ninth interspace in the posterior or midaxillary line. By using this site, I get the advantage of larger interspaces and more easily accessible ribs and a site of drainage which is adequately dependent especially if the patient is lying turned slightly on the diseased side and yet not at a place where the drainage tube is apt to be compressed. When the patient resumes a sitting or standing posture toward the end of the disease, the site of drainage is usually low enough in the thoracic space to take care of even small amounts of fluid and yet not low enough to be covered by the diaphragm.

MULTIPLE ASPIRATION

A closed method of treating empyema is by means of multiple aspirations. It has been known for years that very occasionally a patient will apparently remain cured after one, two or a few aspirations of pus from the pleural cavity. Multiple aspiration was used in the early period of the war and in the days before the war to stave off

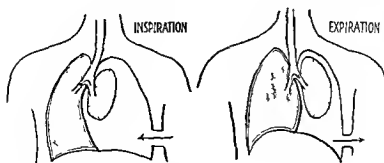


Fig 3. Schmatz's method of pleural aspiration. The patient is placed in the prone position with the head turned to the right. A small wheal is made on the skin with novocain and the interspace is infiltrated by pushing the needle through the skin and subcutaneous and muscle tissues to the pleural space. A small amount of the empyema contents is aspirated into the syringe in order to prove without doubt the presence of the empyema. In a thin individual the needle can not be withdrawn to the site of the puncture being marked by a finger pressed firmly in the interspace. In a stout individual in whom it is impossible to feel the ribs it is best to leave the needle in place as a guide.

the operation of rib resection until such time as it was felt that pleural adhesions had been formed of sufficient strength to stabilize the lung. To my knowledge Dr. Brennenman of Chicago was the first in this country to show a large series of cases in which cures were obtained in the great majority simply by aspiration.

The technique is easy. A thoracentesis is performed and by means of a large syringe the pleural contents are aspirated. If the aspiration is done slowly and the underlying lungs no longer in a stage of active inflammation large quantities of fluid may safely be aspirated. As the fluid reaccumulates the chest is again aspirated and so on until the patient is finally cured or some other form of treatment is instituted.

In my own experience only a very small proportion of patients get well with aspirations alone. I personally have found that the insertion of a tube into the chest can be accomplished with very little more discomfort than the insertion of the aspirating needle and I think a single tube insertion is preferable to repeated aspirations. In infants in whom it may be difficult to insert a tube because of the small size of interspaces the aspiration method of treatment has its greatest value.

I personally have had no experience with some of the more recently reported methods such as aspiration of pus and replacement of a rib or aspiration of pus and replacement of fluid. It seems to me that these methods are much more complicated than the method which I am going to describe next and therefore I can see no advantage in them.

In older children or in adults I resort to repeated aspirations only when for some reason or other tube insertion is impractical.

THE TROCAR METHOD

The simplest method of instituting closed drainage and the one method that I use in the large majority of children and adults is the trocar method.

The site of drainage is determined and the skin over the area is carefully prepared with alcohol ether and iodine. A small wheal is made on the skin with novocain and the interspace is infiltrated by pushing the needle through the skin and subcutaneous and muscle tissues to the pleural space. A small amount of the empyema contents is aspirated into the syringe in order to prove without doubt the presence of the empyema. In a thin individual the needle can not be withdrawn to the site of the puncture being marked by a finger pressed firmly in the interspace. In a stout individual in whom it is impossible to feel the ribs it is best to leave the needle in place as a guide.

With a fine scalpel the skin is incised so that the trocar can be passed easily through it. Holding the trocar firmly in the right hand with the index finger extended to act as a check against a sudden thrust into the pleural space the trocar is firmly but gently pushed through the infiltrated intercostal space into the empyema cavity. Its puncture through the pleura is usually easily realized by the sudden loss of resistance. The catheter carefully tested before the operation and found to fit snugly into the sheath of the trocar.

Now clamped with one of the hemostats at its flaring edge the tip is immersed in sterile glycerin and the assistant holds it by the handle until fits the catheter so that the tip is in close proximity to the end of the trocar. The obturator is withdrawn from the trocar and the catheter is immediately inserted. After the maneuver has been rehearsed a few times before

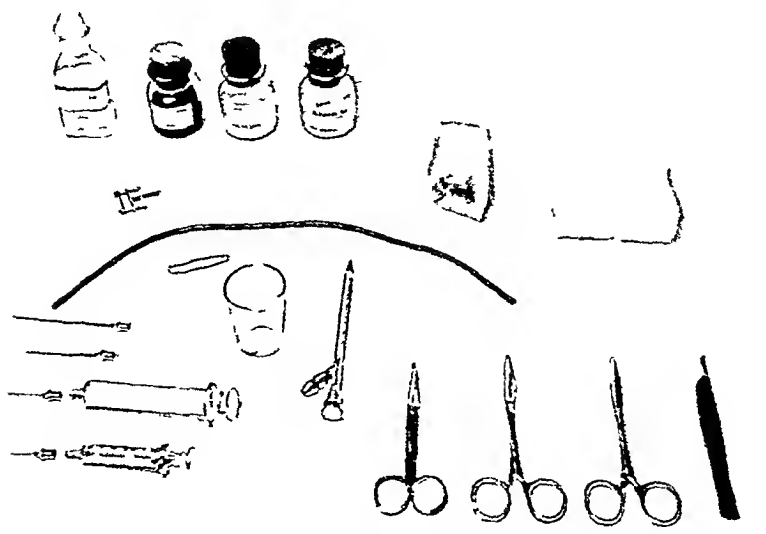


Fig 4 Tray set up for drainage of empyema cavity by the closed trocar method

operation, it will be found that the catheter can be inserted into the trocar in a split second allowing practically no time for the aspiration of air into the pleural cavity.

Almost the entire length of the catheter is threaded in through the trocar into the pleural cavity. The trocar is now gently pulled out of the chest wall and the catheter is clamped at its emergence from the chest wall with a second hæmostat. The first hæmostat is opened, the flaring end of the catheter is cut off, and the trocar is completely removed. In this way, catheter drainage of the empyema cavity has been speedily instituted with a minimum of effort and in an airtight manner.

I use the flaring edge of the catheter, which has been cut off, as a washer. I rethread it on the catheter and push it down until it fits snugly against the small wound in the chest. It will be found that this will hold the catheter firmly. A safety pin is passed through this washer, a small bit of gauze is laid below the safety pin, and by passing two adhesive strips over the pin, the catheter is securely anchored without having the pin forced through the catheter itself. The washer does not hold the catheter so firmly but what it can either be pulled out or pushed further into the chest at will. I usually leave from 3 to 5 inches of catheter lying inside the empyema cavity. It is easy to ascertain the length of catheter inside the cavity by comparing the length of catheter extending from the chest wall with another catheter of similar length. For convenience's sake a small

laboratory clip is substituted for the hæmostat to close the catheter. A light binder is applied to the patient's chest, held by two shoulder straps, a hole in the binder permits the end of the catheter to protrude, and a little pocket holds the catheter and the clip. Thus the end of the catheter is easily accessible.

I should have mentioned when speaking about the anæsthetic that in most children a lollypop given at the beginning of the procedure usually acts as a splendid placebo.

THORACOTOMY METHOD

Occasionally, in larger children and in thin adults, I use another similar method of tube insertion which admits the use of a much larger tube. The drainage tube in this case consists of a No. 24 F or even larger self-retaining Pezzer catheter.

A small bit of silver tubing about $2\frac{1}{2}$ inches long, that is, just long enough to fit through the chest wall, is inserted into the catheter in such a way that it lies a fraction of an inch behind the tip. The diameter of this tubing is such that it fits very snugly and will be held firmly in place by the elasticity of the catheter itself. In order to prevent any possibility of the tube slipping a small perforation has been made in it so that it can be sutured to the catheter. The walls of this silver tube are very thin. The purpose of the tube is simply to prevent the muscles and the ribs from obliterating the lumen of the catheter. The catheter is inserted by means of a thoraco-



Fig. 1. Right thoracotomy. The thoracotome is shown in the position of use. The blades are separated, and the catheter is inserted into the pleural space.

tome which was recently brought over from Professor Frisch's clinic in Breslau and demonstrated to me by Mr. Melle. I had Mr. Mueller cut off the blades to give the instrument more power and at the same time to make it easier to handle. The thoracotome somewhat on the order of the common bivalve gynecoscope the two blades lying very close together when the instrument is closed. Running between the two blades is a thin blade which is removable. The tip of the third blade has been sharpened to a knife edge and is cut in the form of a shallow spoon. With the two lateral blades closed, the median pear blade is the instrument and has used in very much the same way as a cat.

The area is prepared and anesthetized in a manner similar to the one described above. The presence of pus in the pleural cavity is determined before the incision of the skin is made. A length of about three to four inches that is large enough to allow the introduction of the thoracotome. The thoracotome is pushed through the interspace, the first ribs parallel to the ribs. More care must be exercised in forcing the thoracotome through the intercostal space because of the greater danger of injury to the intercostal vessels. When the pleural cavity has been entered the intercostal artery is clamped and blood

in a manner similar to that already described. The blades of the thoracotome are quickly separated. The median blade or burrator is removed and the catheter with its connected silver tube is plunged into the pleural space. The thoracotome is withdrawn and the catheter is thus left in situ in very much the same way as if it had been introduced by the trocar. The catheter is now placed upon the thoracotome so that the silver tubing lies in the interspace guarding the catheter from pressure of the ribs and the bulging opening of the catheter is directed against the pleura. The catheter is held in this position by the diaphragm.

The advantage of this method over the other is that a much larger drainage tube can be used. The disadvantages are that in stout persons where the interspaces are not easily palpable the removal is dangerous in injuring the intercostal vessels.

Occasionally a modification of this technique is necessary in cases in which the interspaces are small. In these cases a portion of the rib is removed subperiosteally and then the thoracotome is pushed through the posterior costal periosteum and pleura into the pleural cavity. After the thoracotomy has been removed the skin is closed and the catheter.

AFTER TREATMENT

The after treatment requires much care and constant supervision.

After the catheter is in place sufficient pus is removed with a syringe to overcome any respiratory embarrassment which the patient may have had. The pus is removed carefully so that the intrathoracic pressure relations are not too speedily altered. In children 250 cubic centimeters of pus is usually the maximum amount removed. In adults twice that amount provided of course the cavity is large. The farther the pleural cavity

is opened through the tube about every three hours the nurse being carefully instructed to allow no air to gain access to the pleural cavity during this apneustic. The best way of enforcing this is to give the order that the tube clip is not to be removed from the catheter until after the aspirating syringe has been put in place and is to be re-applied to the catheter before removing the aspirating syringe to eject its contents. As much pus as can be aspirated is removed although in children I have found it safe to place a maximum of 100 cubic centimeters. After the pus has been removed Dakin's solution of chlorinated soda is injected into the pleural cavity. The amount for injecting the Dakin's solution is not so much as that for the pyemias as to dissolve the thick flakes of fibrin which are found in the fluid.



Fig 6 Roentgenogram showing empyema with tube in place. Note upward course of catheter and absence of lung collapse—compare with Figure 6A



Fig 6A Empyema treated by rib resection and open drainage. Note collapse of lung

Dakin's solution liquefies the contents of the empyema cavity better than any other fluid we have at our disposal. I have tried various solutions, but have come to the conclusion that the full strength Dakin's solution, such as we used during the war, is apparently the best solvent. Incidentally there is no such thing as full strength, half strength, etc., etc., Dakin's solution. Dakin's solution is a specific solution of chlorinated soda, titrated to a definite point and in a proportion such as to yield a definite amount of chlorine. I have adopted as an arbitrary measure for the amount of Dakin's solution to be re-injected into the cavity after each aspiration, one-third the amount of pus that is aspirated. If the pus aspirated is very thick the amount of Dakin's solution is one-half that aspirated. As a rule, the patient is not awakened at night to be aspirated at stipulated times, but the aspirations and the injections are made at about 3 hour intervals, such times as the patient happens to be awake being chosen. After a few days, especially if the tube has been inserted laterally instead of posteriorly and is, therefore, accessible, the aspirations and injections can often be made without arousing the patient.

When the patient's temperature has dropped to normal and his general condition is such that he can be ambulatory, he is allowed to get out of bed. Children are sent to the playroom in wheel chairs as soon as possible. Not until several days after the fever has completely subsided can heliotherapy be given with safety. However, after this time it is recommended if the patient's condition demands it. A high caloric diet is often useful in patients who have been emaciated by the severe previous illness. Exercises, such as bending and reaching, are very helpful in the later stages of the empyema in correcting the tendency toward scoliosis. These exercises, however, are not actually necessary because in the usual case of acute empyema treated by the closed method, no lasting deformity results. The slight scoliosis which is frequently present at the end of treatment is entirely corrected within a week or two, after the child has been turned loose and allowed to play normally.

The use of some artificial means to expand the lungs, such as blow bottles, is seldom indicated in acute empyema when treated by the closed method. If, however, the lungs seem to be fixed and, in spite of aspirations, cannot be expanded, blow bottles may be used. A blow bottle consists



Fig 7 Empty m b d \ t p f t f m t.
g f t b t n d p o c k t w h c h t h t t.
Th c a h p p t b f b t l m p y m a
t e a t e d b y t h l o s e d t o c m t h o d f d

of a set of ordinary laboratory flasks which are so attached that the patient lies at from one bottle to another by blowing a tube. The contraction of the chest wall and the elevation of the diaphragm with pressure against the air within the lungs such as occurs in blowing tends naturally to decrease the size of the empyema cavity. It stands to reason of course that while the patient is blowing the drainage tube must be open. This is best accomplished by placing the end of the catheter in a bottle partially filled with fluid the end of the catheter being well below the fluid level. In this way the chest cavity contracts the contents of the empyema cavity can be forced outward and yet air cannot be sucked into the empyema cavity during the subsequent inspiration. The point should be stressed because I have frequently seen patients given bottles and put to work the attendant at the same time forgetting to open the drainage tube. The result is that the fluid in the empyema cavity being noncompressible the empyema cavity becomes not the slightest bit smaller though the forced contraction of the chest is on the other hand proportionately larger as compared to the lung. In our children's wards we color the liquid in the



Fig 8 Empty m a t d f t m t \ t m p l t
l g x p

blo bottles a different color every day. We frequently make use of a litmus solution to the fluid and change the acidity in the bottles.

The dressings around the empyema tube are changed whenever they become soiled. As a rule the dressings can be left untouched for the first week. After that time a small rim of granulation tissue is apt to form about the catheter and a slight amount of seepage may necessitate a daily change of dressing change of dressing consisting only of removing the soiled piece of gauze and applying a fresh one. This rim of granulation tissue should not be cauterized for or so. In the first place I do not believe that cauterization of proud flesh accomplishes much; a variety of wounds and in the second place the granulation tissue in this instance acts like a valve allowing perhaps a small amount of seepage of mucus and drainage but closing down around the tube during inspiration.

Occasionally toward the end of the treatment the aspirations may be bloody. This is usually due to trauma to the granulation tissue arising about the tube. As a rule this has no significance and requires no change in the treatment. If the aspirations are very blood-tinged it is advisable to aspirate less frequently and to substitute normal saline instead of Dakin's solution for the instillation.

The fever is frequently creased the first day two after the tube insertion but by the third day usually commences to drop and before the week is up may be nearly normal.



Fig 9 Roentgenogram in upright position Empyema with bronchial fistula Note fluid line

The well being of the patient usually improves a day or two after the tube is inserted and continues to improve steadily throughout the convalescence

OBSTRUCTION TO CATHETER

Occasional difficulty in aspirating the empyema contents through the small catheter has been the chief objection to the closed method. Difficulty in aspirating the empyema contents arises from any one of four conditions

- 1 A thick plug of fibrin is sucked into the catheter and obstructs it

- 2 A thick flake of mucus and fibrin, or the lung itself is sucked against the opening of the catheter and thus occludes it

- 3 The contents of the empyema cavity instead of being fluid consist of thick inspissated masses resembling pseudo-membranes

- 4 The catheter ceases to lie in the empyema cavity but lies between the lung and the chest wall

The most frequent of the causes of obstruction is fibrinous plug. The empyema contents are usually rich in fibrin and a clot is frequently aspirated into the catheter. The catheter will usually be blocked at its tip. If enough suction is produced by the syringe the catheter will



Fig 10 Drainage of empyema by closed method in the presence of a bronchial fistula. Note tube leading into bottle filled with water. Air can come out of chest but none can enter. Tube is shown further below the water level than is used in actual practice for the sake of clarity. In actual practice tube should be less than 4 centimeters below the water line

collapse. Occasionally it will be possible to suck the plug through the catheter down to the point of the syringe. In this case, of course, pulling back the plunger of the syringe will cause a vacuum in the syringe but will not collapse the catheter. In this case the fibrin is readily removed by clamping the catheter a few inches from the end and pulling free the syringe while the plunger is still maintaining the suction. The clot will adhere to the syringe.

In order to clear the catheter it is only necessary to force through it 2 or 3 cubic centimeters of Dakin's solution. In certain patients the tendency to form fibrinous clots is greater than in others and in these cases it is advisable to instill a greater proportion of Dakin's solution after each aspiration and to aspirate more frequently.

The empyema cavity almost invariably contains flakes of fibrin. These flakes are often aspirated into the mouth of the catheter. The more suction applied by the syringe the more securely these flakes will close the catheter mouth.

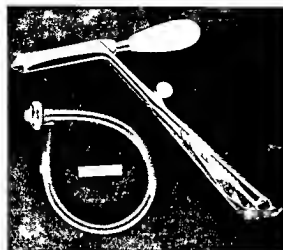


Fig. 1. Modified F. H. B. (I. t. m. t. l. d. dy f. t. m. h. w. b. l. h. t. m. t. m. t. h. t. t. b.) P. a. z. t. h. t. t.



Fig. 2. Modified F. H. B. (I. t. m. t. p. b. l. d. p. d. p. t. t. l. b. l. a. d. m. d.)

As soon as the suction is released the fibrin flake is released. Often the mouth of the catheter lies close enough to the lung so that if forced in suction is made it will be pulled against the

catheter open and will block the drainage. In these instances it will be found that the fluid can be easily injected into the chest but that on attempting to withdraw the tube becomes clogged and collapsed. Very gentle suction, however, will often be successful in aspirating the fluid. Gentle suction can be made with a large syringe. For this as a service the nurses never aspirate through a syringe larger than a 50 cubic centimeter Luer and in case of occlusion change to a 2 or 5 cubic centimeter syringe. Another way of aspirating with the minimum of suction is to fill the catheter with Dakin's solution and then submerge the end of the catheter in a tight rubber part filled with fluid and held several inches below the point of emergence of the catheter from the chest. In this way the chest contents can be siphoned out with a pressure of but a few centimeters of water. A pressure which will not suck the lung against the opening of the catheter with sufficient force to occlude it. If the catheter is against the lung occasionally turning it will direct the lateral opening toward the cavity.

Contrary to what one might assume the tip of the catheter instead of falling downward toward the bottom of the chest cavity when it is inserted strikes the oblique fissure of the lung and is directed toward the apex. This is not at all detrimental. The fact may be beneficial because the injected Dakin's solution thus comes into contact with a greater pleural surface. However, as the treatment continues and the empyema contains diminish and with it the lung is expanded



Fig. 3. Right thorax shown with catheter in place. (I. t. m. t. p. p. e. p. l. e. u. r. a.)

it will frequently occur that the catheter lies pinched between the expanded lung and the chest wall well above the empyema. In this case aspiration merely sucks one or the other of the pleural surfaces into the mouth of the catheter. This condition is easily recognized by X-ray. To overcome this condition it is only necessary to withdraw the catheter a few inches. As the treatment continues the catheter will again have to be withdrawn. In other words, during the treatment of empyema by the method I have described the catheter should be gradually withdrawn. In the cases in which a Pezzer self-retaining catheter is used this will not be necessary because the opening of the catheter lies low down and against the chest wall from the very start.

The following are the standing orders for nurses on my service, when difficulty in aspiration occurs in empyema cases with catheter drainage:

- 1 Always use a small syringe (10 cubic centimeter Luer) and aspirate as gently as possible.

- 2 If unable to aspirate with the usual syringe, try a 2.5 cubic centimeter (hypodermic) syringe.

- 3 If still unable to aspirate inject 5 cubic centimeters of Dakin's solution. If the Dakin's solution is at first difficult to inject and then flows in easily it shows that the catheter is plugged. After the solution has been injected, gentle aspiration with small syringe or with siphonage should be tried. If still unable to aspirate, instill into the chest cavity an amount of Dakin's solution approximately equivalent to one-half the largest amount which has been aspirated at any one time during the last 24 hours and aspirate in an hour. The amount should be instilled only provided the Dakin's solution flows into the chest with but the slightest pressure on the syringe.

- 4 If the subsequent attempt to aspirate is also unsuccessful the interne should be called.

- 5 Force should never be used in aspirating.

WHEN TO STOP TREATMENT

I have one and only one criterion when to stop treatment and that is, *when the empyema cavity is obliterated*. The absence of fever, the improvement in the general condition of the patient, the clearing up of the empyema contents, are all important signs, but none of them can be relied upon as an indication for stopping treatment. The same applies to the careful bacteriological studies of the fluid aspirated from the empyema cavity such as were made during the war and which are still advised by some. No matter how sterile the fluid may be, if the cavity is not com-

pletely obliterated, removal of the tube will be followed in all too high a percentage of cases by recurrences of empyema.

The method of ascertaining when the cavity is obliterated is simplicity itself.

When no more fluid can be injected into the catheter without immediately returning around the sides of the catheter, or actually forcing the catheter out of the chest wound, then the cavity is obliterated.

The length of time for the obliteration of the cavity varies in individuals all the way from 6 days to several months. As a rule, it is safe to tell the patient that the tube will be out in 6 weeks. This usually is from a week to 2 weeks longer than it actually takes, but I have found that a patient is much happier when the treatment is shorter than anticipated, even though the period he expected might have been a comparatively long one.

TREATMENT IN THE PRESENCE OF A BRONCHIAL FISTULA

At least 10 per cent of acute empyemas in infants and a smaller percentage in adults are complicated, either from the beginning or at some time during the early part of their course, by the presence of a bronchial fistula.

The presence of a bronchial fistula can be determined by the fact that the patient coughs up large amounts of purulent material which frequently may be stained, if mercurochrome or gentian violet is injected into the empyema cavity, and by the fact that when the clip has been removed from the catheter and the patient is made to cough, large quantities of air will be forced out of the catheter along with the pus. Often the first sign of a bronchial fistula will be a paroxysm of coughing, following the instillation of Dakin's solution, and the complaints from the patient that he can taste the solution.

If the X-ray discloses a straight fluid line before drainage has been instituted, that in itself is pathognomonic of a bronchial fistula. Incidentally, it is surprising how often this is overlooked. In the non-air-containing pleural space the fluid line is usually indistinct and curving. A sharp, straight fluid line is indicative of fluid with air over it. It is for this reason that X-rays of the chest must be taken in the upright or lateral position.

The treatment of an acute empyema complicated with a bronchial fistula differs from the treatment that I have outlined only in this manner, that a valve is placed at the end of the catheter so that fluid and air can easily escape from

the chest cavity and yet nothing can be sucked into it. The easiest method of constructing such a valve is to attach a 3 foot length of soft rubber tube to the end of the catheter and allow the end of this tube to fall in a glass jar which stands under the bed or if the patient is ambulatory carried around supported from a shin. This jar is partially filled with some antiseptic solution such as permanganate and the end of the rubber tubing is always kept below the fluid level. In this way the air and fluid contents are given free egress from the chest and yet air from the outside cannot gain access to it. Thus all danger of pressure pneumothorax is avoided.

Instead of installing Dakin's solution into the empyema cavity the cavity is irrigated twice a day with normal saline or boric acid solution. If this produces a paroxysm of cough the irrigations are stopped entirely.

The appearance of a bronchial fistula being an attempt of nature to drain the empyema cavity spontaneously closes very promptly after artificial drainage has been instituted and as a rule after from 24 to 72 hours the usual form of treatment can again be carried on.

TREATMENT IN THE PRESENCE OF A BILATERAL EMPYEMA

Not infrequently following a bilateral pneumonia a bilateral empyema will be present. In this case treatment is carried out by the closed method as described. The advocates of the method of multiple aspiration have placed bilateral empyema in the class of cases in which no other type of treatment can safely be used. This is not true. I have never hesitated to treat bilateral cases of empyema effectively as unilateral cases and I have introduced the drainage tube either by means of the trocar or the thoracotomy. Naturally in hospitals in which the treatment of empyema is carried out in a careless manner and the aspirations and instillations are not done with due regard to the advancement of the admission of air into the pleural cavity the treatment in cases of bilateral empyema will carry an additional risk. However, where due care is used there is no more danger in the treatment of a bilateral empyema by drainage than in a unilateral empyema.

TREATMENT IN THE PRESENCE OF AN ACTIVE PNEUMONIA

It occasionally happens that the treatment of an acute empyema must be started on account of the tremendous amount of accumulated fluid while the pneumonia is still active or that a

secondary pneumonia intervenes. The only variations in the treatment of those cases are the following. The aspirations should be done at more frequent intervals so that smaller amounts of fluid can be withdrawn as much fluid as possible should be left in the chest cavity so as to split the diseased lung. In cases of active pneumonia instead of adding only a third of the amount of Dakin's solution it is wise to add Dakin's solution to the quantity of the one half the amount of pus aspirated or to a quantity almost equivalent to that of the pus aspirated. If the pneumonia is very active it may be wise to refrain from using Dakin's solution and to substitute either sterile saline solution or boric acid in its stead so as not to irritate the pleura.

An oxygen tent or an oxygen chamber has been of the greatest help to me in these cases.

ENCAPSULATION

Encapsulation of a certain part of the empyema cavity is not an uncommon occurrence during the treatment of acute empyema. The encapsulation may occur in any part of the chest and may be large or small. It rarely occurs during the early part of the disease.

In the majority of cases these encapsulations are in the nature of a fibrinous agglutination of the two pleural layers which break spontaneously under the increasing pressure of the accumulated fluid. Occasionally however the fibrinous agglutination becomes organized and a firm fibrous encapsulation ensues. In such case the encapsulation will have to be drained.

The diagnosis of an encapsulation is made from the symptoms of the patient and may usually be verified by the X-ray.

The symptoms are a gradual recurrence of the septic temperature curve and a gradual decrease in the well-being of the patient. In every patient in whom after a certain period of normal temperature or a temperature curve which is approximately normal there again appears an increase in the afternoon fever an encapsulation must be kept in mind.

Inasmuch as the encapsulation usually breaks up spontaneously and drains itself into the major empyema cavity no treatment is called for for several days. It is only when the symptoms of encapsulation persist that treatment is indicated. The first step in the treatment will be to locate the encapsulation. The usual physical signs may be of little avail because of the already thickened pleura. The use of the X-ray however will usually show a large encapsulation. It may be necessary to fill the major (that is the drained)

empyema cavity with air to make the encapsulation stand out more clearly. It is advisable to take the X-rays from several different angles if the anteroposterior exposures usually taken show nothing.

Once the encapsulation is localized, the method of drainage must depend upon the site of easiest access. Whenever possible it is preferable to drain the encapsulation directly through the chest wall in the same manner that the primary empyema cavity was drained. If the encapsulation is close to the point of original drainage, it can perhaps be opened by passing some blunt curved instrument through the already existing wound. If it is not possible to reach the encapsulation in this manner, the original opening into the chest can be enlarged by removing the rib above and below (the encapsulation usually occurs above the site of original drainage) and inserting the index finger into the chest, breaking up the encapsulation digitally or with a semi-sharp instrument if necessary under the guidance of a thoroscope (I use a regular cystoscope).

After the encapsulation has been widely opened the treatment is continued as before.

INTERLOBULAR EMPYEMA

As a rule, an interlobular empyema does not present as difficult a problem as would be expected. As the size of the empyema increases it usually works its way, separating the lobes, toward the parietal pleura and at some part or other can be reached in the same manner as any empyema. Therefore, it is well worth delaying treatment if possible until this occurs.

Occasionally it will be necessary to drain the interlobular collection of pus by means of a two stage open operation, the first operation consisting of opening into the pleura by means of rib resection, examining the lung, and forming artificial adhesions by tape insertion. The second operation, 5 to 7 days later, consists of re-opening the chest wall and establishing drainage through the now firmly adherent pleura. In attempting to locate the empyema, a lateral view roentgenogram is frequently invaluable.

DIFFERENTIAL DIAGNOSIS AND THE TREATMENT OF ACUTE OSTEOMYELITIS OF THE UPPER END OF THE FEMUR INVOLVING THE HIP JOINT

I W NATHAN MD FACS N Y

Like all orthopedic surgeons I have from the beginning of my practice in the hospital and out been brought in contact with a considerable number of cases of deformity and disability as the result of acute arthritis. The difficulties that beset the restoration of the patient to even bearable lameness were early impressed upon me and as opportunities for observing these conditions in the early as well as in the terminal stages of the disease increased I soon felt the need for a better understanding of the pathology the diagnosis and the treatment than could be learned from the textbooks on surgery and the general literature.

With the hope of formulating some more definite signs for differential diagnosis and some more definite indications for the treatment during the early stages of the disease so that the unsightly and disabling deformities the long continued upurration so often met with and the chronic invalidism so constant a result of these conditions might be at least mitigated I began in 1908 the study of these conditions here presented. The subject has been with interruptions (the cause for which need not be mentioned here) persistently pursued up to the present time.

I have had opportunities during this period for observing over 200 cases. The greatest proportion of these cases as seen in The Mount Sinai and Mount Zion hospitals and in private practice. Some of these cases were seen in consultation and were treated under my individual control many were seen after they had been treated by general surgeons in this and other cities but 32 were in my hands from the early to the terminal stages of the disease.

I have therefore had the opportunity to compare the results of the treatment of the disease as it is usually carried out in the general surgical services of our large hospitals with that retained when surgical measures are combined with more or less adequate orthopedic measures. And I have I think discovered certain facts regarding the pathology of the condition which to a certain extent at least are qualified to help us in the diagnosis and the treatment of these sometimes so intractable and often fatal diseases.

Obviously it is impossible fully to elucidate the subject within the compass of this paper. I do

I believe that I have by any means approached the ideal that I hoped to achieve when I set out. But the work has helped me in many ways to a clearer understanding of the subject and I hope the results of these investigations will be of assistance to others who like myself must be responsible for the care of these often miserable conditions.

According to the textbooks on surgery and the monographs that deal with this subject the final results of the treatment of the more serious forms of acute arthritis leave much to be desired. Those who have seen a great many cases of this disease and have conscientiously evaluated their results are most pessimistic in their outlook and their statistics show a high mortality rate and a large proportion of the cases with long continued invalidism and permanent functional disability.

The virulence of the disease is held accountable for the large number of deaths. And in acute osteomyelitis which involves a joint and which is accompanied by a violent systemic focus bacteremia so often fatal and an osteomyelitis that is intense spread rapidly and is attended by purulent suppuration will result in much tissue destruction and a more or less complete loss of joint function.

However when I began to have facilities for studying these cases during the early as well as during the chronic stages of the disease I soon discovered that although the disease is often a serious one and difficult to cope with the as nevertheless a not inconsiderable number in which the virulence of the disease and its destructive action upon the tissues could hardly be held accountable for the permanent deformity and disability that had ensued. I soon found a fair percentage of the cases that with adequate method of treatment the mortality from deformity and the marked disability so constantly met with could be mitigated and sometimes altogether avoided. Thus I have not infrequently encountered cases in which the severe form of marked constitutional disturbance (metastases) alone quite fully to dehipoint symptomatic have been taught to believe an characteristic of an acute arthritis of the upper end of the femur with extension to the joint in which I therefore considered the

prognosis as to life or function grave, only to find, that after a more or less stormy course and a protracted convalescence the patient, when certain precautions were taken, recovered without an operation and sometimes with surprisingly little loss of function

As the number of cases of this character that came to me increased, I began to suspect that there must exist a fundamental difference between these cases and the type of coxitis that almost invariably leads to long continued suppuration, frequent recurrences after the disease has apparently subsided, and which so often terminates in amyloid degeneration of the liver and the spleen, and death

Formerly the cases that began with or without serious initial symptoms but which recovered without extensive suppuration, were considered synovial in origin, and for this reason the disease was considered less dangerous to life, and less likely to lead to marked destruction of the articulating bones. But even were it true that these conditions are of synovial origin, and that the process sometimes remains localized, leaving the joint cartilage and the bones free, which as will be shown presently rarely if ever happens, this distinction whatever its merits otherwise, is valueless in the present connection

It goes without saying that in an acute suppurative osteitis an operation is urgently required, often the operation, to be of real service, must be instituted at the earliest possible moment. In the conditions that have been thought to be of synovial origin, on the other hand, an operation is often unnecessary, is on the contrary often actually contra-indicated. Hence the failure to differentiate these two conditions during the early stages, presents a double danger. If one waits until bone necrosis is extensive before an operation is undertaken, not only are the joint tissues irretrievably damaged, but the patient's life is often in jeopardy, if on the contrary one operates before such objective changes are manifest the patient is subjected to a more or less mutilating operation, which is certain to leave him with a more or less completely disabled hip joint, when conservative measures might have brought about partial or complete restoration of function

Obviously then, an early diagnosis is essential if these patients are to receive adequate treatment. If the radical difference which obtained in these different types of the disease is due to differences in the origin of the pathological condition, i.e., if the type which originates in the synovial membrane is the milder and is to be

treated with conservative measures, and the type which originates in the bones is the more serious and nearly always requires early and more or less radical surgical measures, we must, obviously, have the means by which we can differentiate the two types of the disease during the early stages. None of the authors, however, who classify these conditions as synovial in contrast with primary osteal disease specify how these morbid processes can be differentiated clinically from each other during the early stages of the disease

With the advent of radiography it was to be expected that the two conditions could be differentiated from each other by this means. But this hope has proved illusory, for even today with the increasingly great refinements in X-ray technique, it is still impossible to demonstrate bone changes in any form of osteomyelitis during the early stages of the disease. Indeed, such changes only appear in the radiogram when the disease is well advanced, and no earlier in the various forms of primary osteitis than in those in which the bone changes are supposedly due to secondary invasion of the articulating bones as the result of a primary synovial infection. Hence, even were it true that such contrasting conditions actually exist, we have no means of differentiating them at a time when such a differentiation would be of real clinical significance. The constitutional symptoms are similar, the local signs are often indeterminate of one or the other, and the radiograms are often negative or difficult to interpret during the early stages, even in cases that subsequently prove to be typical suppurative osteitides. So, even if this difference in the pathological processes that is supposed to underlie the various forms of acute coxitis were correct, the classification of this disease into synovial and osseous forms is of little help in the clinical differentiation of what are in reality two very dissimilar forms of the disease

As a matter of fact, it was not long after I began my studies of the pathology and pathogenesis of arthritis in general that I began to doubt that such a distinction really exists. The general aspects of the subject cannot be discussed at the present time, but as concerns acute coxitis, facilities for observing a number of cases throughout the course of the disease, have convinced me that in this condition, at any rate, synovial forms do not occur

Thus it is thought that the vast majority of the cases of synovial coxitis arise either as complications of general infections, or spontaneously in young children. In my own experience, however, in all the metastatic joint infections the focus is primarily seated in the bone marrow. In the

DIFFERENTIAL DIAGNOSIS AND THE TREATMENT OF ACUTE OSTEOMYELITIS OF THE UPPER END OF THE FEMUR INVOLVING THE HIP JOINT

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Likewise all orthopedic surgeons I have from the beginning of my practice in the hospital and out been brought in contact with a considerable number of cases of deformity and disability as the result of acute coxitis. The difficulties that beset the restoration of these patients to an even bearable lameness were early impressed upon me and as opportunities for observing these conditions in the early as well as in the terminal stages of the disease increased I soon felt the need of a better understanding of the pathology, the diagnosis and the treatment than could be learned from the textbooks on surgery and the general literature.

With the hope of formulating some more definite signs for differential diagnosis and some more definite indications for the treatment during the early stages of the disease so that the unsightly and disabling deformities resulting from continued suppuration so often met with and the chronic invalidisms consequent as a result of these conditions might be at least mitigated I began in 1908 the study of these conditions here presented. The subject has been with interruptions (the cause for which need not be mentioned here) persistently pursued up to the present time.

I have had opportunities of reviewing this period for observing over 100 cases. The greatest proportion of these cases as seen in The Mount Sinai and Montefiore Hospitals and in private practice. Some of these cases were seen in consultation and I learned much under my own and the training of my colleagues. They had been treated by general surgeons in this and other cities but 32 were in my hands from the early to the terminal stages of the disease.

I have therefore had the opportunity to compare the results of the treatment of the disease as it serves ally carried out in the general surgical services of our large hospitals with the therapeutic results obtained in surgical measures carried out with more or less adequate therapeutic means. And I have I think discovered certain facts regarding the pathology of the condition which to a certain extent at least are qualified to help us in the diagnosis and the treatment of this sometimes so intractable and often fatal disease.

Obviously it is impossible fully to elucidate the subject within the compass of this paper. Nor do

I believe that I have by any means approached the ideal that I hoped to achieve when I set out. But the work has helped me in many ways to a clearer understanding of the subject and I hope the results of these investigations will be of assistance to others who like myself must be responsible for the care of these oftentimes serious conditions.

According to the textbooks on surgery and the monographs that deal with this subject the final results of the treatment of the more serious forms of acute coxitis leave much to be desired. Those who have seen a great many cases of this disease and have conscientiously evaluated their results are most pessimistic in their outlook and the statistics show a high mortality rate and a large proportion of the cases which long continued in validism and permanent functional disability.

The virulence of the disease held accountable for the large number of deaths. And no doubt an acute osteomyelitis which is a lesion of the joint which is accompanied by a virulent staphylococcus bacteremia is often fatal and an osteomyelitis that is intense proceeds rapidly and is attended by profuse suppuration will result in much tissue destruction and a complete loss of joint function.

Here when I began to have facilities for studying these cases during the early as well as during the chronic stages of the disease I soon discovered that although the disease is often a serious one and difficult to treat there was nevertheless a not inconsiderable number in which the virulence of the disease and its destructive action upon the tissue could hardly be held accountable for the permanent disability and disability that had ensued. I found in a fair percentage of the cases that the therapeutic method of treatment that I have unthinkingly

employed and the marked disability so commonly met with could be mitigated and sometimes altogether avoided. Thus I have not infrequently encountered cases in which the high fever, malaise, constitutional distress, metastases, delirium, and exquisitely tender hip joint symptoms have been thought to be characteristic of a violent osteitis of the upper end of the femur with tension on the joint in which I therefore considered the

as sequelæ of other diseases, occurred in connection with mastoiditis. Twenty-three cases of this nature came under observation. Eight seen during the active stage were mild and recovered without treatment directed toward the hip joint. Six were seen late, i. e., after the acute symptoms had subsided, of these, 4 had been treated by arthrotomy and 2 by immobilization after repeated joint tapplings had failed to reveal pus. In all except 1 of these cases there was dislocation of the femoral head and more or less complete ankylosis with adduction and flexion deformity. The 11 remaining I saw comparatively early in the disease, 8 of them continuing in my care until all symptoms had disappeared. In 6 of these cases, treated according to the method to be described later there was complete restoration of function. In 2, who still remain under observation, there is still some disability which is apparently gradually diminishing. The interesting feature in these cases is the fact, that in all except the 8 in which the symptoms were transient, the foci and diffuse rarefaction of the head or neck of the femur, or distortion of the acetabulum could be demonstrated in the radiogram, and that in spite of the obvious signs of bone absorption, there was no supuration.

In by far the largest number of cases of acute coxitis complicating mastoiditis that I have seen, the disease primarily involved the acetabulum and in the majority of the cases that have come to me, late in the disease, the head of the femur was dislocated upon the dorsum of the ilium, and nearly always firmly ankylosed in this position. There are, of course, milder cases which recover quickly, and without deformity, particularly when precautions are taken to forestall the tendency to displacement or ankylosis. However, although the acetabular form is the most common type of the disease met with in connection with mastoiditis, primary foci in the head or neck of the femur, are occasionally encountered. Such a case, with the result when the disease is treated according to the routine that is apparently established in most of our hospitals, is well illustrated in the following case history.

CASE 2. H. E., male 10 years old. Patient had and was operated upon for mastoiditis 10 weeks ago. Although there was not a sinus thrombosis, hæmolytic streptococcus in the blood was repeatedly found. The boy was very ill and ran a spiked temperature for 6 weeks.

He began to complain of pain in the left knee during the third week of his illness, when, on examination, the left hip was found adducted and very sensitive to pressure and passive motion. The joint was aspirated a number of times, but the tap revealed no pus or excess of fluid in the joint. As the joint became more sensitive and the patient

complained of great pain, a plaster-of-Paris spica was applied 6 weeks ago. Two weeks ago the spica was removed.

When I saw him on September 10, 1924 the hip joint was apparently firmly ankylosed in flexion and abduction. The radiogram showed osteitis of the upper end of the femur and the acetabulum. From the appearance in the picture (Fig. 3) I was led to believe that the joint cleft still persisted. I, therefore, instituted traction in order to correct the deformity and if possible to restore the mobility by means of passive motion. This proved unsuccessful, and after 3 weeks' trial was abandoned.

Three weeks later he was walking in a brace, but, although he was comfortable, the deformity still persisted. When I saw him last, about 6 months after the illness, he was walking without pain on a flexed adducted hip joint. Correction of the deformity by means of osteotomy was advised, but declined. I am sure that had the traction and passive motion been applied early in the disease, this hip would have been saved.

In the light of my experience with the cases of acute coxitis that came to me as complications or sequelæ of the general infections, I feel justified in assuming that all these conditions are actually metastatic bone infections and that the joint infection is always secondary to a primary lesion in the bone. These conditions are mild and transient, or benign, because the infection is not sufficiently virulent to cause extensive bone changes and actual joint invasion, and not, as most authors formerly believed, because the disease begins primarily in the synovial membrane.

If these forms of the disease, which can be dealt with only summarily here, are excluded from synovial type of the disease, we have only the conditions that occur in young children and infants to consider as remaining in this group. These conditions vary greatly in their virulence and their influence upon the future function of the hip joint. In many of these cases, the disease is mild, transient, and resolves without causing permanent damage to the hip joint. These need not detain us here. In others, the disease takes on the well known characteristics of what is known as infantile epiphysitis, and in these there is always more or less destruction of the articular ends of the bone, nearly always supuration, and occasionally permanent disability. There can hardly be any question, that these conditions are due to metaphyseal infection and, as will be shown later, the primary seat of the disease is in the bone.

If then we must, from our experience of recent years, conclude that all the metastatic forms of acute coxitis are primarily metaphyseal or epiphyseal infections, and this assumption seems eminently justified, we are forced to the conclusion that the more serious forms of what was formerly believed to be a malignant form of synovial coxitis of cryptogenetic origin are also of the same nature.

On April 10, the general condition was good, the affected limb could be moved in all directions without pain, and the patient was up in a wheel chair.

On May 1, patient was up, and was able to walk with the aid of crutches. Radiogram showed the bone practically restored to its normal density.

On June 1, patient was walking in a caliper brace, she was in perfect health, and was able to get around without pain or discomfort. The caliper brace was discarded in August, 1924, and the patient was soon thereafter, able to walk without discomfort, and when examined a few months later walked without pain or limp. She has had no recurrence of the trouble.

CASE 4 F. C., female, aged 14 years. Four weeks ago patient complained of sore throat and headache. Temperature was 102 degrees F. The following day the temperature rose to 104 degrees F. and the child became delirious. The throat was red, the urine negative. The temperature remained high, varying from 103 degrees F. to 105 degrees F. for 8 days, and although the child cried out when she was moved, she continued to be delirious, and no definite objective signs which could be held accountable for the condition could be made out. According to the history sheet the urine examined on the eighth day showed albumin and red blood cells. A blood culture taken at the same time was positive for streptococcus hemolyticus.

The temperature of a remittent type remained high for several weeks longer, but the delirium gradually subsided, and during the third week of the illness, she had lucid intervals during the day. When awake she complained of intense pain over both hip joints, she cried out in her sleep, and resisted any attempt to move the limbs.

I saw this little girl on August 20, 1919, 5 weeks after the onset of the illness. She was much emaciated, very irritable, and very difficult to examine. Both hips were somewhat flexed, adducted, and apparently immobile. There was some oedema over the hip joints, but I could not make out any signs of deep fluctuation. It was quite impossible, owing to the pain and the resistance of the child, to bring the hips anywhere near the normal position. She was, therefore, anesthetized, when the hips could be brought down without force, and traction and counter-traction could be applied. During the following week it was necessary to administer codeine and aspirin, in order to keep the child comfortable, but soon thereafter the pain gradually subsided, and about 2 weeks later it was possible to begin very gentle passive motion. A radiogram taken on August 28, showed marked rarefaction of the heads and necks of both femora, infraction of the neck of the left, and coxa vara of the neck of the right femur. It was, therefore, considered advisable to discontinue the passive motion. Nevertheless, the motion in the hip joint remained comparatively free, and an X-ray film taken on September 15, showed the position of the bones unchanged and a considerable increase in the density of the head and neck of the femur.

An X-ray picture taken on October 10, showed marked increase of the density in the bones, but the fracture line on the left side still distinct (Fig. 5). The patient was now quite well and insisted upon moving about in the bed, and was impatient to get up. It was, therefore, with considerable difficulty that we were able to keep her recumbent until the first week in November, when she was fitted with a brace which supported both hips and the pelvis, but permitted flexion and extension of the joints. A month later the patient was walking about with the brace, she had no discomfort, and was permitted to move the hips freely without weight bearing. A radiogram taken at this time showed the bones to be normal in density, and the fracture on the left side to be united. There was coxa vara on both

sides. At Christmas the child walked well without noticeable limp, and had apparently completely recovered. She remained well until February, 1920, when she had an attack of appendicitis and died after the operation.

CASE 5 J. G. aged 30 years, was admitted to the medical service of Mt. Sinai Hospital October 3, 1923. Six weeks ago patient had a slight infection of the lip, for which she applied home remedies. The swelling nevertheless increased and extended to the cheek and closed the right eye. In about a week the swelling and the pain somewhat subsided, but toward the end of the second week the patient had a chill, which was followed by fever and delirium. The condition in the lip and face slowly subsided and was apparently completely healed 4 weeks after the onset. The fever and delirium lasted 3 weeks. When consciousness was completely restored, she found that she was unable to move the right lower extremity, and the most gentle attempts at motion caused the patient excruciating pain.

Status on admission. Patient was an emaciated woman, who lay immobile in bed, and cried out when she was moved. Her temperature was 101.4 degrees F. The internal organs, the urine, and blood (with exception of a secondary anemia) presented no pathological changes. There was tenderness over the right thigh and hip joint, most marked over the great trochanter. There was a pressure sore upon the right heel, and decubitus covering an area of about 4 inches in diameter over sacrum. Radiogram of the hip joint showed an erosion of the head of the femur and the opposing surface of the acetabulum.

Patient was transferred to the orthopedic service of the hospital on October 10, 1923. She resisted any effort to move the right lower extremity, but by exercising great care in the examination, it was possible to elicit some motion in the joint, but motion was so painful that a complete examination was impossible. Although the soft parts over and surrounding the hip joint were somewhat oedematous, there was apparently no considerable effusion in the joint interior. Temperature, which had been remittent in type, was today 102 degrees F. Radiogram showed an extension of the process previously reported.

Owing to the presence of the decubitus, the patient was placed on the abdomen, and traction was applied in this position. On October 17, the patient was much more comfortable, and it was possible to move the hip joint without causing nearly so much distress. Temperature did not rise above 100 degrees F. She did not object to the prone position.

From this time onward, the condition gradually improved. The temperature did not rise above the normal after 2 weeks, and the calcaneal, and the sacral decubitus gradually healed. Passive motion in the affected joint became less and less painful, and with persistent but gentle passive motion and continuous traction, the motion increased until it approached the normal in about 8 weeks after admittance. The clinical signs of improvement were accompanied by corresponding changes in the appearance of the articulating bones in the radiogram. Thus, on November 12, 1923, the report from the laboratory reads: Examination of the right hip joint shows a destructive bone disease of the head of the femur as well as of the acetabulum. The appearance is that of an osteomyelitis. The osteomyelitic process is more advanced than at the last examination. On January 23, it was reported that there was a marked improvement as compared with the last examination. There appeared to be some reconstruction of the previously decalcified areas in the bone.

The patient's condition continued to improve, the motion in the hip became painless and on April 2, when she was discharged from the hospital, the motion in the joint was quite free in all directions, and she was able to

ing the hip joint. The radiograms, moreover, show the pathological changes that are usually considered to be characteristic of this condition. Thus, Case 3 shows the extensive and intensive rarefaction of the bones of the femur and acetabulum, Case 4, coxa vara and infraction of the neck of the femur, Cases 5 and 6, the circumscribed lesions, and in Case 7, the radiogram shows the complete dislocation of the head of the femur on the dorsum of the ilium, lesions which are considered characteristic of the various types of acute suppurative osteomyelitis of the upper end of the femur involving the hip joint.

But, despite the parallelism of the general symptoms and the objective changes, these cases present nevertheless a very important feature, which must inevitably distinguish them from the cases of true suppurative osteomyelitis which involves or is likely to involve the joint.

This distinction lies in the fact that in the condition from which these patients suffered, the patient recovers from the disease without operative interference. Not only does he recover from the initial infection, but in striking contrast to the final outcome so inherent in the true forms of suppurative osteomyelitis of the upper end of the femur, the patient remains free from chronic suppuration and never suffers from the recurrences and metastases which are, in my experience, inevitable in the latter condition when treated by conservatory surgical measures. In the case histories which here follow, this contrast is well exemplified.

CASE 8. M. D. I first saw this patient in private practice in 1912, when she was 10 years old. She came to me for a painful adducted left hip with a secreting sinus in the groin and another in the gluteal region. She was said to have had an osteomyelitis of the upper end of the femur about a year before, which had been treated by operation. The head of the femur was said to have been removed. I opened the hip joint for the removal of a sequestrum. On coming down upon the bone (Langenbeck incision), I found that there still remained a portion of the head *in situ* firmly synostosed with the upper border of the acetabulum. The sequestrum was removed, the deformity corrected, and the limb was immobilized in a plaster of Paris spica. The sinus remained open, and discharged for several months after the operation, but finally closed, and the recovery was otherwise uneventful.

The sinus remained healed for about 6 months, and then re-opened, discharging for 3 weeks. After this, although the sinus in the buttock remained closed, the one in the groin had re-opened on an average of about once a year until 1916.

She came to me on May 1, 1917, complaining of pain in the middle of the right arm. On examination I found a hard swelling over the middle third of the humerus which, in the X-ray picture, proved to be a bone abscess. This was opened and drained for about 4 weeks, when the wound was permitted to close. She had no further trouble with the arm. But during the following 7 years, the sinus in the groin repeatedly opened and discharged pus, until

finally it remained patent throughout the year of 1924. In 1925, her general health was poor. I, therefore, advised her to have the hip resected but this was refused. She was then advised to go either to Switzerland or to southern California. She went to California where she remained until 1928. When I saw her again, she gave a history of having had another focus in the upper end of the left humerus which had been opened, and which now gave her no further trouble. The sinus in the groin, however, was again discharging and the right hip was painful. Resection of the hip was again advised, but declined. The duration of the illness was 18 years.

CASE 9. J. O., male, aged 9 years, was admitted to the Mt. Sinai Hospital, June 27, 1926. Patient had a sore throat 3 weeks ago. A few days ago, after an insignificant trauma, he complained of pain in the left lower extremity, his temperature rose, and he appeared to be profoundly ill. His temperature was 104 degrees F.

The very sick child cried out when examination was attempted. The internal organs showed no abnormality. The left hip was swollen, exquisitely tender, and both voluntary and passive motion was restricted. Blood cultures were positive for staphylococcus aureus, 30 colonies to the cubic centimeter. The hip joint was incised when a large amount of pus was evacuated. The condition remained unimproved during the next few days. Blood cultures were still positive, and the micro-organism was also cultured from the urine.

On July 1, the temperature was 104 degrees F. The wound was re-opened and drill holes were made through the trochanter into the neck of the femur. The temperature remained high after the operation. July 7, blood culture showed staphylococcus, 15 colonies to the cubic centimeter. Blood culture on July 8 was sterile. A week later there were swelling and pain in the right shoulder, this subsided spontaneously within a few days. Repeated X-ray examinations showed an osteomyelitis of the upper end of the femur and of the ilium. On August 17, roentgen examination of the left hip and thigh showed an osteomyelitis extending from the head of the femur to the shaft below the trochanter. The upper two thirds of the shaft had become a sequestrum much surrounded by involucrum.

On August 11, a sequestrum was said to have been removed. Radiographic examination on September 2, showed an osteomyelitis of the left femur involving practically the entire shaft, the original bone forming one large sequestrum surrounded by an involucrum at least one half inch in thickness. The head of the femur seemed to be intact but separated from the neck of the bone, and there appeared to be some productive changes about the hip joint apparently extending from the upper lip of the acetabulum to the femur.

He was discharged from the hospital on October 26, with a temperature of 100 degrees F, and the hip still draining. He was to be dressed at home. He was readmitted to the hospital December 28. One week ago an inguinal abscess opened spontaneously. He was said to have had a temperature of 103 degrees F. The old wound on the external aspect of the thigh was still draining. Treatment consisted of rest in bed and dressings. The temperature soon came down to normal and he was discharged from the hospital February 14, 1927. The wound was still draining.

Patient was readmitted to the hospital July 26, 1927. He remained in bed for several months after he was last discharged from the hospital. He then was able to be about with brace and crutches. He felt fairly well until 3 months ago, when he began to have recurrent pain in his left elbow which lasted for from a few hours to several days. Temperature was 100 degrees F. The arm was swollen and hot and the pain kept him awake at night.

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In the light of the generally accepted teaching the cases here recorded would have the local condition been recognized during early stages of the disease had been regarded as cases of acute osteomyelitis of the upper end of the femur with involvement of the hip joint. They would therefore for the most part have been subjected to some form of active surgical procedure. And if we evaluate the general and local symptoms and the local signs as shown in the radiogram such treatment if the accepted technique is correct would be eminently justified.

In these cases we have the usual serious constitutional disturbance, the local objective signs of an acute tetis or osteomyelitis, and

likely to re-open after a longer or shorter interval and again secrete pus and discharge bony sequestra

There is always sequestration. The sequestra may be massive or they may be small, they may remain *in situ* for many years slowly disintegrating, or small particles from the free sequestrum are more or less constantly being discharged from the sinuses that remain permanently open or re-appear as the diseased bone is forced to the surface of the limb. Recurrences in cases apparently healed many years before or acute exacerbations in chronic cases almost always supervene and secondary foci in the other bones or elsewhere are often met with both early and late in the disease. Finally, a considerable number of the cases, to judge from my experience in private practice and in the Montefiore Hospital, eventually succumb to suppuration in vital organs or amyloidosis, the result of years of more or less continuous suppuration.

As soon as I began to appreciate the dissimilarities that exist in the two forms of what I had been led to believe to be a single entity, I began to treat the cases, not by radical surgery during the acute stage as my early training had influenced me to do, but by conservative measures, that is, by mechanical or conservative procedures. As my experience became more extensive and I began to have the facilities of following the cases more closely over long periods, delaying operative interference as long as possible in the absence of demonstrable suppurative osteitis, when I could do so without seriously endangering the patient's life, the view that such contrasting forms of osteitis actually exist became more and more convincing.

Nevertheless, the period during which I awaited the appearance of definite differential signs was always fraught with considerable anxiety to the patient's relatives and to myself. For this reason if for no other, the want of a method by which these two, as I felt convinced, very distinct morbid processes could be distinguished from each other during the early stages became more and more insistent. I tried various methods, the nature of which need not detain us, to overcome this difficulty without success until at last I tried, what according to the generally accepted teaching appeared to be the least hopeful, to segregate the cases according to the type of the invading micro organism.

Hitherto, it had been generally assumed that acute coxitis or osteitis was caused by a number of different organisms, the staphylococcus, the streptococcus, and the pneumococcus being con-

sidered the most common causative agent. It was thought that all these organisms were capable of causing an acute or chronic suppurative osteitis of the hip or any other joints. Of these the staphylococcus was considered the most frequent cause of the disease, but the streptococcus and the pneumococcus were thought to be equally capable of causing a morbid process that differed in no wise from the condition caused by staphylococcus aureus. That this view was not absolutely true first suggested itself to me when I began to see a considerable number of cases of osteitis as complication or sequela of mastoiditis. In these as is generally known, the hæmolytic streptococcus is quite the most common invader, and, as in these cases prolonged suppuration of the joints, rarely if ever, supervened, the possibility suggested itself that the differences that prevail in the two types of acute coxitis might be due to the differences in the pathological changes that are caused by the activities of these invading micro-organisms.

As my facilities for bacteriological examination increased I began to segregate the cases that came to me during the early stages according to the organism found in the blood or in the joint exudate. Thus, all cases that showed streptococci in culture or were doubtful, were treated by conservative or rather by mechanical means. I soon found that this method of segregating the cases was of eminent practical value. For, guided by this method of segregating the cases, I found myself in a position, in by far the largest proportion of the cases, to determine from the beginning just which cases would eventually require surgical intervention, and which cases could be effectually treated by conservative or mechanical means.

I could be certain that a patient with an acute streptococcus coxitis would rarely if ever require an operation and that, with the exception of the most virulent forms of streptococcus septicæmia, a patient with this form of coxitis would, with proper management recover without suppuration or recurrences, sometimes with fairly good motion in the joint, or at least, the joint firmly ankylosed in good position for function. As my material became more and more abundant, the evidence in favor of this method of grouping the cases and its clinical implications grew so convincing that I no longer hesitated to treat, as shown in the first group of cases recorded above, all cases of acute coxitis upon this basis no matter how threatening the general constitutional disturbance.

I found of course, that a streptococcus infection with a focus in the hip joint or elsewhere may be very virulent and sometimes end fatally. But

Although it was noted that an abscess cavity was entered at the time of operation, no mention is made of the presence of pus in the joint and it is stated that no pus was found upon drilling into the spongiosa of the neck of the femur. This is, of course, not surprising in this case when the radiograms are examined. The reports read September 11, 1925, rarefaction of the upper end of the femur. September 23, negative except for the operative procedure. December, osteomyelitis of the upper end of the femur which is dislocated upward on the ilium. My examination of the X-ray pictures convinced me that the changes in the upper end of the femur were, for the most part if not entirely, caused by operative procedure. At any rate the fact that the dislocation ensued is good evidence that the acetabulum was involved and was in all probability the main seat of the disease. Hence, even were this a case of staphylococcus, the procedure here adopted would have been unavailing. In the present instance having to deal with a case of streptococcus, involving for the most part the acetabulum, the procedure was entirely ineffectual. The precautions that are necessary to maintain the femoral head in its proper relation with the acetabulum were neglected during the early stages of the disease, with the result that although 4 years have elapsed without a recurrence and without a sinus, the child is left, as is shown in Figure 11, with the femoral head dislocated and ankylosed upon the dorsum of the ilium. He has a flexed and adducted hip, no motion, considerable shortening, and will have permanent disability.

The course of the disease and the terminal conditions which ensue when these patients are treated according to the methods customary in many of our large hospitals at the present time, are still more graphically illustrated in the following case.

CASE 12. R. B., aged 5 years and 11 months. Two weeks ago he had an abscess of the mouth (?) for which two teeth were extracted. Five days later he vomited, complained of pain in the abdomen, and had a high fever. On the second day of the illness he complained of pain in the left lower extremity. He had had several chills the night before he entered the hospital. He was admitted to the private pavilion of the Mt. Sinai Hospital on December 23, 1928. His temperature on admittance was 102 degrees F. He was irritable and cried out when moved in bed, and complained of pain in the left hip. The internal organs appeared normal. The hip was not swollen. Blood culture was positive for streptococcus hemolyticus. A radiogram taken December 27, 1928, failed to show any abnormality in the pelvis or the hip joint. Diagnosis: sepsis with osteomyelitis of the upper end of the left femur. Operation consisted in an osteotomy of the left

femur for osteomyelitis. The operative diagnosis was osteomyelitis of the upper end of the left femur. Pus was obtained on incision and roughened bone was found at the depth of the incised area.

As the child continued to run a high temperature the hip was again explored on January 12, 1929. Exudate from the joint and the marrow cavity examined bacteriologically was found to contain streptococcus hemolyticus in pure culture. The child was placed in an overhead traction, both hips being held at right angles.

An X-ray picture taken January 24, 1929, showed a complete dislocation of the left hip, the hip riding high above the acetabulum. There was evidence of a bone defect on the superior aspect of the great trochanter and the neck of the femur, probably due to an operation (Fig. 13).

The patient continued to run a septic temperature, but seemed somewhat more comfortable after traction was applied. The radiogram taken March 11 (Fig. 14) showed that there was considerably more absorption in the region of the head and neck which was operated upon, and there was in addition some bone proliferation on the mesial aspect of the neck of the bone. The right hip previously reported normal, showed an upward dislocation of the head of the femur.

I saw the child on March 20, and as the temperature had been down to almost normal for several weeks I advised that an attempt be made to reduce the dislocation by gentle manipulation, and if this proved successful to maintain the reduction by traction and counter traction with the hips in extension. When I saw the child again, early in April I found the hips still dislocated. The temperature rose immediately after the manipulation, and had remained high since then. The right hip was now tender and there was an edematous swelling over the joint which extended over to the dorsum of the ilium where there appeared to be some fluctuation. The patient was transferred to my service in the Mt. Sinai Hospital.

During the next week, the swelling over the hip joint became more marked, the pain in this region became more intense, and the temperature reached 104 degrees F. On April 10, 1929, I incised the fluctuating mass over the hip joint. I entered a well defined abscess cavity which apparently did not communicate with the hip joint. The contents of the abscess were typical of an infected hematoma which, I thought, resulted from the manipulations employed in the effort to reduce the dislocation of the hip. The abscess was treated by thorough and through drainage.

The fever gradually subsided, the drains were removed 2 weeks after the operation, and the wound closed promptly. The child was sent home to convalesce on May 4. At this time he had little fever, and there was no pain when the extremities were held in traction. The hips were fixed in flexion and adduction.

At home the wound from the last operation soon closed and the general nutrition improved immensely. When I saw the child again during the middle of June he was comfortable, his temperature had been normal for some weeks and he was able to move about the bed without pain. The hips were still fixed in the deformed position. He continued to improve during the summer months, so much so, that he was out of bed walking in a support in September. He was again radiographed December 5, 1929 (Fig. 15). There was found some restoration of the density of the bones, but the hips were firmly synostosed above the acetabulum. When I saw him a few weeks ago he was walking without support, he had no pain, and there were no signs of abscess. The gait was characteristic of that which usually ensues when the hips are dislocated and synostosed on the dorsum of the ilium.



Fig 1 Typhoid infection of the hip joint The disease has involved the head and neck of the femur as well as the acetabulum

over the great trochanter, was aspirated. The tap contained blood and pus, which according to the laboratory report, contained staphylococcus aureus and albus in culture. On June 1, the abscess cavity was opened, the trochanter bared, and the underlying bone curetted. The granulation tissue and pus removed were cultured and showed the presence of staphylococcus aureus. Early in July the temperature rose somewhat, remaining continuously at 102 degrees F, with only very slight morning remissions. There was only a scanty discharge from the wound, and the X ray showed very little extension of the disease process in the bone. Nevertheless, the general condition of the patient noticeably declined. The liver and the spleen became enlarged. Blood culture made on July 20 was sterile. He was transferred to the Montefiore Hospital, where the symptoms of amyloidosis became prominent, and he died in November, 1925. The duration of the illness was 11 months. In this case a focus in the trochanter and the neck of the femur, which was apparently circumscribed and which did not penetrate the joint, was the cause of a rapid decline and death from amyloidosis within a comparatively short time.

As a general rule, the patients who die within a short time after the onset of the disease are characterized by a staphylococcus bacteriæmia. In the case just described, however, the blood culture was sterile, and in this respect the case is somewhat unusual. As a general rule, such cases make at least a partial recovery and run a course similar to that which obtained in the Cases 9 and 10.



Fig 2 Gonococcus infection of the hip joint resulting in complete synostosis. The focus in the head and the acetabulum is well shown.

In the next case, on the contrary, the course was an unusually long one, and amyloidosis occurred only after a prolonged period of apparently good health.

CASE 14. C. K., was admitted to the Mt. Sinai Hospital, April 28, 1923. He was discharged July 24, 1923. Diagnosis pyarthrosis of the right hip joint. Operation included incision and drainage. The chief complaint was pain in the right knee of 7 weeks' duration. Patient did not recall childhood diseases. He was operated upon for an abscess of right thigh 14 years ago. A nasal operation was performed 3 years ago. Present illness began about 7 weeks ago, when patient was awakened by severe pain in the right knee. He applied iodine and in a few hours the pain disappeared, only to reappear again 5 weeks ago. This time pain persisted and patient went to Lincoln Hospital, where X-rays of hip and knee revealed nothing (to patient's knowledge). He was put in Balkan frame for 5 days, but could not stand the pain, and therefore went home. During this time he had fever varying between 101 and 102 degrees F. Pain was most severe in the knee, radiating to right hip, and sometimes to the leg and the foot. Pain was worse on movement.

Examination of extremities revealed the right lower extremity apparently shorter than left, the right thigh adducted, and the leg flexed. There was atrophy of thigh and leg muscles on the right. The knee and hip were very tender, but there was no swelling, no redness, or heat. The knee could not be fully extended, but could be full.



Fig 5 Radiogram of the hips of a patient who suffered from a streptococcus infection. The disease has subsided and the recondensation of the bones is advancing (Case 4)

the Montefiore Hospital for treatment. Here, although the albumin and casts in the urine persisted, and the spleen and liver continued to enlarge, he improved for a time, but the improvement was only temporary. There soon appeared oedema of the extremities and ascites, and he gradually lost strength, and died from amyloidosis 2 months after admittance to the hospital. The duration of the illness was 29 years. There was a quiescent interval of 14 years. This long period was, I think, due to the fact that he had almost complete synostosis of the articulating bones.

These 2 cases present the extremes of what usually happens in these conditions. As a general rule the course of the disease in the cases of more or less localized staphylococcus osteomyelitis of the hip joint is neither so short in the acute cases without bacteraemia nor do such long periods of complete quiescence occur in the more or less chronic forms of the disease. The cases just described must, as far as the course of the disease is concerned, be considered exceptional. As a rule, the disease pursues the course which, in its principal features, resembles that which pertains to the Cases 8, 9, and 10 already mentioned. The condition in the latter had not at the time they were last seen reached its terminal stage, but from experience with a large number of these cases, I do not hesitate to predict that these, just as in the cases last mentioned, and the vast majority of the cases treated by conservative surgery that have come to me during the past 25 years, will sooner or later succumb to the disease itself, or the sequelæ and complications to which it gives rise. My conviction, which has grown stronger with years of added experience, is that staphylococcus osteomyelitis involving the hip joint is a most intractable condition and always leads sooner or later to a fatal termination when treated according to the generally accepted teaching here in the United States at the present time.



Fig 6 Radiogram of the hip joint of a patient who recovered from a hæmolytic streptococcus infection with complete restoration of function (Case 5)

Much to my surprise, I have found, as my studies on this subject have progressed, that the results from conservative surgery as generally practiced in most of our large hospitals were, in spite of the vast improvement in surgical technique and hospital facilities, far behind the results obtained by the radical measures employed in the last decade, when resection of the hip was practiced, as a routine measure, in all cases of acute coxitis with symptoms of sepsis.

In some of these cases, it is true, the hip was resected when so radical a procedure was unnecessary or even contra-indicated. Thus I find



Fig 7 Ankylosis of the hip joint as a result of a hæmolytic streptococcus infection (Case 6)



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Fig 10 Recurrent staphylococcus infection The disease is still active after 8 years (Case 10)

when even conservative operative procedures are contra-indicated. On the other hand, when all patients are treated by conservative surgery, even in the presence of outspoken evidence of supuration and massive bone necrosis, the results are poor indeed, and many patients are doomed to die after perhaps years of disability and invalidism.

It is hardly necessary to multiply the examples. The cases of streptomycosis I have described, show very clearly that these conditions are curable without an operation no matter how alarming the symptoms may appear during the early stages provided the proper mechanical measures are instituted. When the mechanical measures are neglected or inadequate as in the Cases 11 and 12, the patient may recover from the infection and may remain free from recurrences, but he is left with a deformed or dislocated hip, and more or less complete and permanent disability. On the other hand, the cases of staphylococcus infection illustrate the usual result when only conservative operative measures are employed. In these the recovery, should it occur, is rarely permanent,



Fig 11 Streptococcus coxitis treated by operation. This condition is most often met with by those who see these patients late (Case 11)

the patient after a long siege of acute and dangerous illness is left with a deformed hip and with a secreting sinus which may remain open and active over long periods of months or years, and he finally succumbs to an acute recurrence or to chronic, suppurative, multiple foci and amyloidosis.

Even in some of the very few patients that apparently recover completely, and apparently remain well for years (Case 14), the danger of recurrence and terminal amyloidosis remains a constant menace. Few general surgeons have the opportunity of following these cases over a period of years, and few if any, are confronted with the end-results as they are met with in orthopedic practice and institutions like the Montefiore Hospital, where the terminal conditions that result from this disease are only too painfully evident. It is unnecessary, nor does space permit the recording of the many cases of this nature that I have encountered in the institution mentioned, during the past 20 years. Here we always have numerous cases of this nature, that remain for long periods in custodial care until death terminates the patient's suffering.



Fig 8. Dissection of the hip joint. (C 7)



Fig 9. The dissection of the hip joint. (C 7)

cases reported in Klemm's monograph on osteomyelitis in which resection was performed in the young children even in streptococcus infection or in older children in whom from the nature of the symptoms as described such a practice is contra-indicated. But when the operation was practiced in suitable cases and at the proper time as it was for instance in Koenig's clinic in Tuebingen the operation was often a life saving measure and in a great many instances saved the patient years of suffering and invalidism. Thus Koenig reports the results in 75 cases of resection of the hip for acute suppurative arthritis. Only 6 were discharged from the hospital with cures. The majority of the cases were well and able to walk in between 6 and 8 weeks after the operation. Nine died and 65 completely recovered.

It is to be noted that in the cases reported by Koenig resection was performed in only those in which there was a clearly demonstrable suppurative osteomyelitis. Koenig still believed that some of the cases that came to him were synovial in type and therefore one of the cases were operated upon during the early stage of the disease even when as rarely happened the patient was brought to the hospital at the beginning of the illness.

In this country on the other hand patients suffering from these conditions are brought to the hospital much earlier than they are abroad. Most often they come in during the acute stage when

the destruction of the tissues is not advanced even in the staphylococcus infections and hence the differential diagnosis from the ordinary clinical findings even if it is considered as difficult or impossible to substantiate. The surgeon hesitates to operate when there are no signs of pus or he finds that simple incision and drainage or even an expectant attitude often lead to an amelioration of the symptoms. Under these conditions the patients suffering from the streptococcus and pneumococcus form of the disease finally recover without a certain amount of disability and those with the staphylococcus forms either die or leave the hospital with a milder disability but joint and most often with a discharging sinus.

Thus it has come about that in this country at a very early resection of the hip has been entirely abandoned as a routine measure and conservative operative surgical measures are more and more generally employed in not only the less serious cases where such measures are frequently harmful but they are also employed in the staphylococcus infections where such measures are totally inadequate. In my experience as exemplified by the illustrative cases here recorded neither the conservative nor the radical treatment is effectual when used as routine measures.

When resection is employed in all cases in which the early symptoms are acute and alarming without reference to the nature of the infection many cases are unquestionably subjected to operation



Fig 10 Recurrent staphylococcus infection The disease is still active after 8 years (Case 10)



Fig 11 Streptococcus coarctatus treated by operation This condition is most often met with by those who see these patients late (Case 11)

when even conservative operative procedures are contra-indicated. On the other hand, when all patients are treated by conservative surgery, even in the presence of outspoken evidence of supuration and massive bone necrosis, the results are poor indeed, and many patients are doomed to die after perhaps years of disability and invalidism.

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Fig. 1. Early stage of the disease. The patient is lying down, and the surgical team is performing an operation. The image is somewhat dark and grainy, typical of early 20th-century medical photography.



Fig. 2. Late stage of the disease. The patient is lying down, and the surgical team is performing an operation. The image is somewhat dark and grainy, typical of early 20th-century medical photography.

I cannot at the present time report in detail the statistics of a large number of cases in order to show that the well directed radical treatment in staphylococcus is the only method that is likely to afford permanent relief in this condition. The statistics from Koenigs clinic are quite sufficient to indicate that the conception of the disease here advocated is well founded. Here only a few cases need be recorded to illustrate the results of properly applied radical surgical treatment as compared with the so called conservative measures usually advocated.

C. S. A. G. admitted to the Polytechnic Hospital. The patient was 30 years of age, married, and had three children. The patient had been ill for several months, and the disease had progressed to a late stage. The patient was brought to the hospital by a friend. The patient was found to have a large, hard, and tender swelling in the right breast. The swelling was about the size of a walnut and was located in the upper outer quadrant. The patient had no pain, but the swelling was noticed by the patient's mother. The patient had no other symptoms. The patient was examined by the physician, and the diagnosis was made. The patient was then operated on. The operation was a radical mastectomy. The patient was then treated with antibiotics. The patient was discharged from the hospital after a few days. The patient has since been well and has no recurrence of the disease.

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Fig 14 A still later stage of the disease as exhibited in Case 12. The child has been in traction with both hips in flexion and adduction. Note that the hip in which the disease had up to this time been unsuspected, is now displaced.



Fig 15 Radiogram of the hips from Case 12 after the disease had completely subsided.

Three days later, the pain became localized to the outer side of the left thigh. He was admitted to the Beth Israel Hospital, where he remained for a year. During this period he suffered intermittently from pain in the thigh, and fever up to 102 degrees F. The left thigh was incised for relief of abscesses a number of times. An abscess in the right forearm was also incised and drained. A plaster spica to the limb was more or less continuously worn during his stay in the hospital.

On admittance to the Montefiore Hospital the findings were as follows: Patient was a well developed but thin and anæmic boy who showed signs of a wasting illness. The internal organs showed no gross abnormality. A scar 5 centimeters in length was present on the right forearm. Motion in the joints was normal. The right lower extremity showed no abnormality. On the left lower extremity there was a scar 18 centimeters in length over the lateral surface of the thigh. There was also a scar about the size of a half dollar below the anterior superior spine of the ilium. The motion in the hip joint was more or less completely restricted and the patient complained when one attempted to move it. There was some loss of motion in the knee joint. The foot was fixed in equinus and was painful to passive motion. The left extremity was 2 centimeters shorter than the right.

The sinuses reopened soon after patient entered the hospital. His condition remained unchanged until April 17, 1924, when it was noted that he had had more pain in the hip, some temperature rise, a considerable increase in the discharge from the sinuses, and a marked deterioration of the general health during the previous 2 weeks.

On June 11, an incision 4 inches in length was made over the anterior surface of the thigh, extending downward from the anterior superior spine of the ilium, the joint was explored and curetted. Considerable dead bone remained. Three days later an abscess over the outer side of the thigh was incised. All the wounds were debrided. Two days later two more openings appeared on the posterior lateral surface of the thigh.

On July 30, all the sinuses, 6 in number, were discharging freely. For the past few days the patient had been complaining of pain in the thigh. He had been restless and unable to sleep. Temperature was up to 102 degrees F. Patient felt better and the pain had almost disappeared.

On February 15, 1925, examination was again made. The discharge from the abscesses gradually had diminished during August and September, and he was fairly

well during this time. Early in January, the swelling and the pain in the hip gradually grew more pronounced, and a few days ago the abscess again opened spontaneously. Since then he has been somewhat relieved. From November 15, 1925, to February 24, 1926, he was given radiotherapy. The disease was apparently somewhat mitigated though he suffered from more or less acute recurrences until February 5, 1927, when the condition appeared quiescent, and he was discharged from the hospital. Repeated radiograms taken between this date and January 28, 1925, are reported to have shown a considerable advancement of the disease. On the latter date the process was reported considerably improved.



Fig 16 The result of early resection of the hip (Case 15) for staphylococcus infection, and subsequent osteotomy for adduction deformity.



Fig. 7. Lat. resect. of the hip joint. Staphylococcus infect. (Case 16)

Fig. 8. R. d. gram. Lat. resect. of the hip joint. Staphylococcus infect. (Case 16)



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The first case is a typical example of a staphylococcus infection of the hip joint treated according to the more or less generally accepted method now in use in this country. This boy after the usual conservative treatment continued to be acutely ill for several months. His temperature

sight, I did not remove sufficient bone from the acetabulum, and the adjacent portions of the ilium. Hence although the patient (2 years after the operation) walked well without pain and with very little limp, he still had a sinus, very minute and only occasionally giving rise to an exceedingly small amount of discharge it is true, but still enough to indicate that the operation was not so extensive as to carry the resection well into normal bone.

It must be strongly emphasized, however, that although occasionally one may save a patient by resection after the disease has existed for a considerable length of time, in the vast majority of the cases the life of the patient, certainly his well-being, is seriously jeopardized when so long a period is allowed to elapse before resorting to this measure. For such patients are threatened with secondary foci, as is exemplified in Cases 9 and 10, rather early in the disease, when the operation is nearly always unavailing, or the patient becomes so debilitated, because of the long continued supuration and the recurrent bacteriæmia, or the disease becomes so extensive, as for instance in Case 9, that the operation offers little hope of success.

On the other hand, I am far from advocating that a radical operation be undertaken during the early stages of a staphylococcus infection of the hip joint, even when the diagnosis is assured. There are a number of reasons why this is inadvisable. First, the bacteriæmia or the sepsis that obtains during the early stage of the disease renders the operation one of much more danger than it is later when the intra-articular pressure has been relieved by incision and drainage. Second, because it is often difficult at this time to determine the extent and the location of the disease by means of the X-ray or by the appearance of the tissues when they are exposed.

It must be noted, that the mere fact that there are signs of acute coxitis and staphylococciæmia, does not always indicate that the disease is actually located within the capsule of the joint. It should be remembered that an osteomyelitis involving the bones of the pelvis adjacent to the hip joint, or one that involves the upper end of the femur on the distal side of the epiphyseal line often gives rise to an effusion into the joint and joint spasm before the joint is actually invaded. It is, of course, a grave mistake to open the joint under these circumstances.

It would lead too far to discuss the latter conditions at the present time, they are well described in the exhaustive textbooks on surgery. During the early stages the diagnosis is some-

times somewhat difficult and during the advanced stages of a virulent infection is often substantiated too late to be of avail in saving the hip joint and the patient's life. In the less virulent forms of the disease, I should say in the majority of cases, the fact that one has this possibility in mind, will often lead one to recognize the morbid condition, and its location. The situation of the abscess, moreover often points to the source of the infection. Thus tumefaction or an abscess that occupies the dorsum of the ilium, or the pelvis, is fair assurance that the disease is situated in the ilium and thus the point of attack is plainly indicated. In such cases resection of the diseased portion of the bone not only prevents the spread of the disease to the joint but often brings the morbid process to an abrupt conclusion. It is unnecessary to illustrate the point here, the condition is well described in the literature and in the monographs on the subject.¹

There are still other reasons why early resection in all cases of staphylococcus coxitis should be deprecated. These rest upon the peculiar development and anatomical conditions that obtain during infancy, childhood, and adolescence. These developmental and anatomical peculiarities have a very important bearing upon the location and the course of the disease, particularly as it affects the head and the neck of the femur.

It has long been known that micro-organisms elect certain circumscribed regions in the bones, as their favorite sites for localization correspond to the terminal blood supply of the affected bones. In the growing individual this lies in the metaphysis of the long bone. Here the blood supply is most abundant, and the blood current is retarded—ideal conditions for the localization of infective foci. Hence, as concerns the upper end of the femur, the primary site of the disease will vary with the age of the individual. In young infants in whom the head and the neck of the femur are still wholly cartilaginous, the disease will invariably be situated on the distal side of the epiphyseal line, and as a consequence distal to the insertion of the capsule. For this reason in the milder cases the disease runs its course without involving the head and the neck of the femur and without invading the interior of the joint. Moreover as the bones at this time are soft and friable massive necrosis does not take place, and as the tissues are less resistant than in older children the abscess will practically always seek a vent externally. In many of these cases, the abscess opens spontaneously before the diagnosis has been made,

¹See Tillmann, *Die Verletzungen und chirurgischen Krankheiten des Beckens*. Lieferung 6 a 1903.

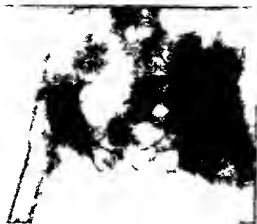


Fig 7 Lat es t f th h p f r staphyl
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Fig 8 R d g m l l t at g th p r s t f
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o f t h e f e m u r T h i s I d i d n o t f u l l y r e a l i z e a t t h e
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There are still other reasons why early resection in all cases of staphylococcus coxitis should be deprecated. These rest upon the peculiar development and anatomical conditions that obtain during infancy, childhood, and adolescence. These developmental and anatomical peculiarities have a very important bearing upon the location and the course of the disease, particularly as it affects the head and the neck of the femur.

It has long been known that micro-organisms elect certain circumscribed regions in the bones, as their favorite sites for localization correspond to the terminal blood supply of the affected bones. In the growing individual this lies in the metaphysis of the long bone. Here the blood supply is most abundant, and the blood current is retarded—ideal conditions for the localization of infective foci. Hence, as concerns the upper end of the femur, the primary site of the disease will vary with the age of the individual. In young infants in whom the head and the neck of the femur are still wholly cartilaginous, the disease will invariably be situated on the distal side of the epiphyseal line, and as a consequence distal to the insertion of the capsule. For this reason in the milder cases the disease runs its course without involving the head and the neck of the femur and without invading the interior of the joint. Moreover as the bones at this time are soft and friable massive necrosis does not take place, and as the tissues are less resistant than in older children the abscess will practically always seek a vent externally. In many of these cases, the abscess opens spontaneously before the diagnosis has been made,

¹See Tillmann: Die Verletzungen und chirurgischen Krankheiten des Beckens. Lieferung 622, 1905.

and at most simple incision and drainage bring the disease to a conclusion. More virulent infections often course along the ossification line and destroy the connection between the neck and the shaft of the bone when the head and neck more or less completely degenerate and there remains only a rudimentary connection between the shaft of the femur and the acetabulum. In many of the cases of so called infantile epiphysitis there is in spite of the apparently marked distortion of the head and neck of the femur as seen in the radiogram surprisingly little disability as the children grow older. Thus I have seen not a few adults who had suffered from this condition in infancy who walked without perceptible limp and suffered no inconvenience whatsoever from the results of the disease of early life.

It may therefore be concluded that a staphylococcus infection of the hip joint even when the disease has actually invaded the joint interior is a much milder condition during early infancy than it becomes at a later period in life. It is true that in some cases the disease is very virulent and soon leads to a fatal termination, but if the child recovers from the bacteriæmia the disease runs its course acutely and there is rarely danger of recurrence and chronic suppurative infection.

It must be admitted however that although this is true in by far the majority of the cases there are occasionally cases to be met with in which the disease after the subidence of the acute symptoms runs a chronic course and gives rise to metastases even in the erythrocytes. But even in these I feel that radical measures are either contraindicated or difficult to evaluate. I have for example till in my care a case of osteomyelitis on the distal side of the proximal femoral epiphysis which originated when the child was a year old in which a secondary focus appeared in the tibia a year later when as shown in the epiphyseal union of the radiogram (Figure 18) the femoral focus appeared to have become circumscribed and as apparently underwent spontaneous resolution. However such cases are exceptional and I think that it is hardly open to question that staphylococcus infection in or near the hip joint in very young children and infants should be treated by conservative surgical measures and that although it is true that a deep abscess should be incised as soon as there are signs of fluctuation a radical measure should be instituted in these cases.

As the child grows older the local anatomical and developmental condition change. The neck of the femur formed by the proximal extension of the shaft of the femur and the epiphyseal line

comes to lie within the capsule of the hip joint. As soon as this change takes place osteomyelitis of the upper end of the femur unlike the disease as it affects other bones here it only occasionally invades the neighboring joint by extension of the pathological process through and beyond the epiphyseal line situated within the joint capsule from the beginning. Under these circumstances when the abscess within the synovial space breaks through the cortex it communicates directly with joint interior causing a suppurative arthritis.

Obviously there are no capital foci until the ossification center for the head has been laid down and has begun to grow. The controversy as to the comparative frequency of capital and cervical foci arose because this fact was not taken into consideration when compiling statistics in this regard. My own experience which in great measure agrees with that of Koenig has led me to believe that capital foci become more and more frequent as the child grows older until adult life when capital foci or diffuse infiltration of the head practically always usher in the pathological process. As ossification in the head and neck of the bone advances the thickness of the epiphyseal disk that separates the head from the neck gradually diminishes and at a stage is finally reached when they are separated from each other by a very fine line of growing cartilage. During this period the focus of disease appears on either side of the epiphyseal disk on the subchondral region.

As Koenig has well shown the pathological process in staphylococcus infection closely resembles the tuberculous focus in the manner of localization and the manner of invasion. And except that the most important changes in the bones caused by staphylococcus infection progress much more rapidly there is little to distinguish the terminal lesion from that of tuberculosis.

The disease as it occurs in the acetabulum is obviously subordinate to the developmental condition on that obtained in this region. Here too the original focus lies extra-articularly during early infancy but in this situation the ossification centers are laid down much earlier than they are in the head and the neck of the femur. In fact the bone arising from the pubes ischium and the ilium has advanced so far as to be connected with the joint before the end of the first year. For this reason a focus laid down in one of the bones that make up the acetabulum is intra-articular at a time when a focus in the femur would still be outside of the joint. This is to say that primary intra-articular foci in the hip appear during early life.

originate and are often confined to the acetabulum. This inference is borne out by the fact that the abscess which appears in these cases usually points in the buttock.

Staphylococcus infections are as a whole, much less frequent in infancy and early childhood than are the streptococcus and the pneumococcus infections. Thus I have records of 20 cases with bacteriological examinations in children under 4 years. In these the streptococcus hæmolyticus was found in 8 cases and the pneumococcus in 6 cases. I have not searched the recent literature for confirmation of my own conclusions as to the comparative frequency of these infections in infants and young children, but in his book on osteomyelitis, Klemm, in speaking of osteomyelitis of the hip joint, reports 23 cases in children under 4 years of age. The bacteriological findings in these cases are strikingly similar to those in my own cases. In 9 he found streptococcus hæmolyticus, in 7 the pneumococcus, and in only 6 staphylococcus aureus. If we reckon the pneumococcus, which causes analogous changes, with the streptococcus infections we find that of the 20 of my own cases 14 of 20 and in Klemm's 16 of 23 were caused by organisms that cause morphological changes which differ radically from the more malignant staphylococcus infections.

Now it is a fact, which I continually verify by additional cases, that the streptococcus and the pneumococcus infections are much more frequently primarily located in the bones of the acetabulum than are the staphylococcus infections. The frequency with which one meets dislocation of the hip during the early stages of the disease in these infections certainly bears out this conclusion. In infants and young children, therefore, osteomyelitis primarily located in the acetabulum must be by far the most common condition first, because the ossification centers appear earlier in this situation than they do in the upper end of the femur, and, second, because, in them, the disease is, in by far the majority of the cases, caused by either streptococcus or pneumococcus infection.

We may say with some assurance, therefore, that the acute suppurative or non-suppurative infections of the hip joint in infants and young children are much more benign conditions than they are in later life. There is less bone to undergo sequestration, there is less danger of permanent damage to the periarthral tissues even when the disease is due to the staphylococcus, and lastly the disease is most often caused by the less destructive organisms—the streptococcus and the pneumococcus—from which the patient may re-

cover with perhaps some impairment of joint function, but without the danger of chronic suppuration recurrence and metastases. Hence, the question as to the therapeutic measures to be employed in acute coxitis during infancy and early childhood is not difficult to answer. In view of the facts here brought out it is clear that radical measures are seldom necessary. They are certainly contra-indicated in the cases due to streptococcus and pneumococcus infections, which form the largest contingent of the cases and, although there is a question whether staphylococcus infection, in which a more or less circumscribed focus persists and which is for this reason likely to give rise to metastases as for example in the case from which the radiogram is reproduced in Figure 18, should not be eradicated as soon as possible, it nevertheless remains true, that in the majority of the cases of staphylococcus infection at this time of life, the operation may, indeed should be, delayed until the conditions for this operation are favorable, that is until the bones are so far developed that an ankylosis of the hip is assured.

For it must be emphasized that in resecting the hip for staphylococcus infection, the mere removal of the head of the femur does not satisfy the requirements for a permanent cure. The conditions are similar to those that obtain in tuberculosis in which it is necessary to insure a true bony synostosis, that is, the joint cleft must be completely ablated, and the connection between the articulating bones converted into dense bone if the disease is to be permanently eradicated. This, of course, is difficult to attain during early childhood, and it is for this reason, and for this reason only, that I am advocating delay in subjecting the patient to the operation at this period of life.

Now whereas infants and young children are apparently much more susceptible to streptococcus and pneumococcus infections than they are to staphylococcus infections, this relationship undergoes a radical change as the child grows, is as a matter of fact reversed. For in my experience, which is verified by statistics that already exist in the literature, the staphylococcus infection is much more frequently the cause of acute coxitis in later childhood and adolescence than is either the streptococcus or the pneumococcus, and it is at this period of life that the most typical cases of acute suppurative coxitis, such as have been exemplified above, are most frequently met with. Curiously enough, the relative frequency of these infections again undergoes a change as we reach adult life. Here the streptococcus and pneumo-

coccus more particularly the former again become the predominating I might say practically the variable cause of the disease. All the cases of staphylococcus coxitis in adults that have come under my observation have been recurrences of an infection that dates back to early life (as for example Case 14). Nor can I recall a single case of the disease in an adult in which I could not be certain either from a bacteriological examination or from the course of the disease that the condition was caused by either a streptococcus or a pneumococcus.

Acute streptococcus coxitis in adults as exemplified by the Cases 5, 6 and 7 presents all the essential features that characterize the disease in children. There is never long continued suppuration or a chronic osteomyelitis after the subsidence of the acute attack, when there is an abscess this soon clears up after spontaneous perforation or incision and when the rarefied bones are protected from injury and the articular surfaces are maintained in their proper relation and the mobility preserved by gentle passive motion the patient will often completely recover his health and although for obvious reasons not so regularly with a hip joint that has lost little or none of its normal functional power. On the other hand when these precautions are neglected the patient is left with a stiff and deformed hip and more or less completely disabled a disability which can only to a certain extent be corrected by painful and time consuming orthopedic measures.

The observations here presented must I think help to clarify our views regarding osteomyelitis of the upper end of the femur involving the hip joint. They must if my interpretation of the findings is accurate lead us to believe that the disease is not as hitherto been taught a more or less well defined entity which can be treated by some typical standard formulae surgical or mechanical procedure. We find that it is not true that the morbid condition the clinical course and the termination is the same irrespective of the radiogram. That on the contrary the character of the invading organism is chiefly if not altogether responsible for the changes that ensue and for the ultimate condition that arises and the sequelæ that follow the disease.

I believe and the facts as here presented bear me out that we must divide the case of osteomyelitis of the hip into two classes.

1 The streptococcus and the pneumococcus forms.

2 The staphylococcus forms.

The streptococcus forms differ from the staphylococcus forms in a number of very important details. In some cases the disease is mild and runs a short course and often ends in complete recovery. But the disease is not mild as was formerly believed because it is synovial in origin or because there is simply a synovial effusion (the marrow in the epiphysis is here as well as in the more serious forms the original seat of the disease) but because the invading micro-organisms exert a much less serious deleterious effect upon the tissues. In the more serious forms of streptococcus infection the constitutional reaction is profound the pathological process spreads rapidly within the marrow of the epiphyseal ends of the bones causing intense rarefaction which leads to distortion of the head and neck of the femur or the acetabulum or both. The disease spreads to the joint interior and the synovial membrane and finally leads to destruction of the joint tissues with deformity of the articulating end of the femur or dislocation. However although the condition as a part of a general sepsis may terminate fatally as a general rule after a more or less stormy or long continued illness which leaves the patient seriously debilitated and with a more or less disabled hip the disease finally subsides and unlike the condition caused by the staphylococcus it is very rarely if ever followed by recurrence. There is rarely profuse or long continued suppuration in these conditions. At times there is a seropurulent exudate which is occasionally tinged with blood. This exudate like that contained in the subcutaneous abscesses which are not infrequently found in streptococcal sepsis is nearly always rather promptly subsides after spontaneous perforation externally or after simple incision.

Streptococcus coxitis never leads to mass necrosis and sequestration. There is at most a diffuse infiltration of the marrow and often extensive rarefaction but unlike the condition which prevails as a result of staphylococcus infection there are no large sequestra and although infection of the rarefied neck of the femur may when the parts are roughly handled occur I have never found the head of the femur completely separated from the neck and lying in the joint cavity.

These facts well apprehended indicate the indications for the treatment of this condition are clear. As there is no suppuration within the bone as there is no sequestration and as there is little danger of extension of the morbid process to the central marrow cavity a radical operation is unnecessary. On the contrary inasmuch as by far the majority of these cases will recover under conservative

treatment, radical surgery is to be deprecated. It is not only ineffectual but during the acute stage of the more serious infections it is an added menace to the patient's life. On the other hand, though radical operations are never called for, and by far the greatest number of patients recover without any surgical intervention at all, it does not follow that these conditions require nothing but the expectant and symptomatic treatment, that they so often receive when they are not heedlessly subjected to operation. Such a course may be less dangerous to the patient's life than an operation, but in all but the mildest cases, does nothing to prevent the irretrievable damage to the joint structures which, unless some precautions are taken to forestall them, must follow the pathological changes in the articular ends of the bones and the periarthritic tissues. The bones are rarefied and the capsule is distended, hence, unless these structures are protected from the handling necessary for the care of a very sick patient, the neck of the femur will be fractured or deformed, the contours of the articulating surface of the head of the femur will be obliterated, or because of the absorption of the acetabulum rim the head of the femur will be dislocated, and the joint becomes fixed and permanently disabled. Seldom is this eventuality comprehended by the average surgeon or practitioner, and rarely does one see a case of acute coxitis late in the disease in which there is not some and often serious permanent disability. Cases 11 and 12 are typical examples of what one constantly meets with in practice and in the hospital and such results are only too often reported in literature.

The treatment for these conditions is simple and only rarely difficult to carry out effectively. Traction by means of adhesive plaster straps extending from the trochanter to the malleoli is a ready means of maintaining the surface of the articulating bones in their proper relations without at the same time completely immobilizing the joint. It must be well appreciated that the object to be attained is not only the relief of pain and the prevention of deformity but the preservation of the mobility of the joint. Traction properly applied relieves the joint spasm within a surprisingly short time. The patient soon becomes more comfortable, and, if applied early enough, that is before distortion, dislocation, or synostosis has occurred, gentle passive motion to maintain the mobility (varying, of course, with the intensity of the pathological process) is soon borne without too much discomfort. Gradually the motion may be increased and in the course of a

comparatively short time a considerable range of motion may be established, not only in the cases that are apparently recovering from the infection, but even in those in which the temperature is still high and the constitutional symptoms are still profound.

By means of traction and assiduous attention to the carrying out of passive motion, I feel sure that I have been enabled to prevent the distortion, dislocation, and loss of motion so inevitable in many of these cases, when the disease is at all pronounced and extensive. In older children and in adults, it is easy to carry out by anyone who has the necessary knowledge and the modicum of skill in its application. Occasionally, it is true, some ingenuity and a considerable amount of patience and tact are required to carry out the treatment effectively. For obvious reasons it is impracticable in young infants. But in them the disease when virulent is nearly always fatal, and in the less virulent cases is less destructive than at a later age and, for this reason, it is not so likely to lead to serious disability even when the condition is left untreated. In older children and in adults there are sometimes complicating conditions (as for example in my Case 5, a patient in whom a very extensive bedsore on the sacrum necessitated the application of traction with the body prone), when some little skill is required to attain the effect desired, but on the whole no difficulties are encountered, and with care and patience and a little tact these patients can either be completely restored, or at least relieved with the joint synostosed in the most favorable position for function.

It must be emphasized, however, that the treatment must be inaugurated during the early stages of the disease. No treatment is likely to be effective after the joint ends and the periarthritic tissues have been seriously damaged. I have had little success in restoring motion in joints synostosed even when the position was good. Nor can I feel so sanguine as to the end-results, although some authors report good results, after closed or open reduction of the dislocated hip. Except in the cases that have been seen very early, that is, soon after dislocation had taken place, have I been successful in maintaining the reduction permanently. I find them not difficult to reduce when synostosis has not occurred, but even in the cases, of which Case 7 is an example, in which the trochanter is transplanted down on the femur the hip has redislocated as soon as weight bearing was resumed.

It would unduly widen the scope of the present paper were I to enter into a discussion of the

detail of the treatment of streptococcus infection of the hip joint. From what has been said it must be clear that streptococcus as well as pneumococcus infections of the hip as well as of other joints is a morbid process that disseminates radically from staphylococcus infection. That other than the incision of an abscess surgical—certainly not radical surgical—procedures are contraindicated and that with reasonable care and intelligent supervision many perhaps the majority of the patients suffering from these conditions can be more or less completely restored to health without undue loss of the joint function.

If venous infection to the staphylococcus infections must, if my interpretation of the observations here presented is correct, conclude that we have in them an entirely different morbid condition to deal with. The initial symptoms it is true and the general symptoms of sepsis are indistinguishable but in the other clinical manifestations and in the local changes in the bones and the periparticular tissues they are altogether dissimilar. In contradistinction to the conditions which are inherent in streptococcus and pneumococcus infections there is in staphylococcus cortical abscess mass or necrosis which invariably leads to sequestration and chronic suppuration. The acute symptoms may, if the patient survives the sepsis subside but recurrences at longer or shorter intervals are bound to occur so long as the diseased bone remains *in situ*. This dead bone which is either attached or free in the interstices of the joint cavity is never spontaneously extruded. Small sequestra come away from time to time but the large ones remain behind and from time to time give rise to acute exacerbation and metastases. Even when the disease begins as a circumscribed focus as exemplified in Case 3 the condition pursues its malignant course and unless radical measures are instituted finally leads to a fatal termination. It is true that in some cases a long period may elapse before the morbid process again becomes active but as in Case 14 sooner or later it again gives rise to the constitutional symptoms in the other bone until finally the patient ceases as a result of the chronic suppuration and the consequent amyloidosis.

It should be understood that the cases here recorded particularly Case 9 and Case 10 are not selected because they are unusual. On the contrary these cases are selected because they represent what one constantly meets with both in hospital and private practice. Just as in these cases the vast majority of the patients are brought to the hospital during the acute stage the abscess

is opened the bone either drilled or cut out and perhaps a sequestrum removed and he is discharged after a more or less serious stage of illness with either a draining sinus or with the disease apparently quiescent. He usually has the motion in the hip more or less completely restricted in a deformed position and in consequence is lame or must use some apparatus or crutches to be about. He may be fairly well for a while but the symptoms sooner or later return when he is readmitted to the hospital and the series of events of his first admittance are repeated. Again he is discharged either quiescent or with a sinus which may drain for weeks months or years when the disease again exacerbates and gives rise to metastases. This series of events is repeated time after time until the patient is either operated upon radically or he succumbs to a metastasis in one of the internal organs general sepsis or amyloidosis.

In an experience of at least 25 years I can remember not one patient over 10 years of age who has suffered from an acute staphylococcus arthritis in whom the disease did not become chronic or in whom the lesion healed spontaneously or as the result of conservative surgery. Only in one case have I been enabled to save such patients from the unhappy future so inevitably in store for them and that is by completely eradication of all the diseased bone and securing a bony ankylosis of the hip in good position. In these cases I still see no reason to change the attitude I felt compelled to assume toward tuberculous of the hip joint in 1903. I still remain convinced that these patients are never cured until the joint is completely obliterated and an end joint is substituted. As concerns tuberculous it is in my opinion a needless matter that in the high latitudes of Switzerland the patients get all the anatomical joint. I have not seen a great many patients who have been favored with the treatment these regimens. But in the few that have come to my notice and whom I have had the opportunity to observe over a number of years the cure did not seem to me to be permanent. In the majority of them exertion often brought on pain and spasm and only with the exercise of great caution in the use of the limb and excellent general hygienic condition of the patient these patients more or less free from symptoms. Considerable experience with similar treatment in this country does of by any means lead me to anticipate that our efforts in this direction will be successful. However, whatever may be the conditions as concerns tuberculous

I am fully convinced from my own experience in these cases, and the results of conservative treatment as they come to me from many skillful surgeons, that so long as we have not a specific treatment for staphylococcus our only hope of saving these patients years of suffering and a fatal termination is the complete ablation of the hip joint with ankylosis in good position¹

I freely admit that this is an admission that our surgical treatment in this disease is to a certain extent at least inadequate. We are, of course, substituting a mutilation for a cure. But this must remain true in many of the morbid conditions that come to the surgeon for operation because there exists no medical treatment likely to effect a cure.

However, although I must admit that complete restoration is a desideratum, I do not feel that an ankylosed hip is so serious a handicap that every effort should be made to secure a movable joint no matter what the pathological condition, despite the slender chance of success, the inordinate loss of time, and the trouble involved, and despite the hazards entailed. I have patients with such hips who have become so accustomed (particularly when the resection and ankylosis dates back to early youth) to lost motion, and so skillfully utilize the motion of the pelvis on the normal head of the femur, that they are practically unconscious of the disability, hardly limp, and are able to perform strenuous work without the least discomfort or fatigue. Resection of the hip without ankylosis for the relief of the condition we are now discussing cannot be too strongly condemned. This operation not only leaves the patient with an unstable hip joint, but unless the femoral stump later becomes synostosed with the acetabulum which causes adduction deformity and shortening, it lays the patient open to recurrent staphylococcus infection, which in the end, after months or years of incapacity and suffering, leads inevitably to his death.

How soon after the diagnosis is positive, resection should be undertaken cannot be stated categorically. I have found that, unless the conditions are progressing very rapidly and the general conditions are becoming more alarming, it is better to open and drain the abscess and await a favorable moment, that is when the temperature is approaching the normal and the general condition has taken a turn for the better, before resorting to the operation. On the other hand, when the morbid process is, as for example in Case 9, extending rapidly, particularly when it is extend-

ing toward the shaft as well as toward the ilium and the blood cultures continue to show the presence of staphylococci, the operation should never be delayed for, once the disease has advanced to the marrow cavity of the shaft of the femur or has invaded the pubes or the ischium, the time when a radical operation is likely to be successful has passed and the patient's chances for recovery have vanished.

Once the inferences to be drawn from the observations here described are well comprehended, the differential diagnosis between the two morbid conditions should present no difficulty. The bacteriological examination of the blood or the exudate will nearly always reveal the organism. With the present day hospital and laboratory facilities, such examinations are readily obtained. In the very virulent forms of infection with either organism, the patient often dies before the diagnosis is substantiated. In the less serious cases, as has been shown here, there can be no harm in waiting for the signs that help to differentiate the two forms of infection. When coxitis is suspected, traction should be applied. This relieves the acute suffering within a comparatively short time, and thus permits of repeated, careful examinations of the affected region. When fullness over the hip joint or the per-articular structures is discovered, one must be on the lookout for deep suppuration. Only when one has assured oneself that actual fluctuation exists should one proceed to incision.

I have never regretted awaiting the unequivocal signs of deep fluctuation before entering the hip joint. Nor do I see any advantage, on the contrary I think it somewhat hazardous, to resort to repeated aspiration in an endeavor to establish the presence of an abscess. It is far better to maintain the traction and do nothing else until one is actually convinced that suppuration exists before resorting to surgical measures. By so doing, one often finds that one is dealing with a streptococcus infection and the disease can be brought to successful conclusion without an operation. It is true, of course, that the serious and sometimes ominous symptoms sorely tempt the surgeon to pursue a radical course, before the indications for doing so are decisive, but I feel that the surgeon who assumes an expectant attitude toward these cases and operates only in the presence of actual suppuration, will often be gratified by a surprisingly good result in what first appears to be rather a desperate case.

No doubt, with the rapid advance in the distribution of hospital facilities and the rapid strides that are constantly being made in bac-

¹ Mechanics and pathology of tuberculous hip-disease in their relation to its diagnosis and treatment. J. Am. M. Ass. 1915 LXV 173.

teriological technique blood cultures during the early stages of the disease will be available even in the most distant hamlet and this period of anxious waiting will no longer confront the physician who for the present must forego these advantageous aids to diagnosis. As a matter of fact the majority of cases of staphylococcus infection of the hip from the outlying districts do not reach the surgeon until the sign of an abscess or suppuration are unmistakable. Once signs of an abscess or suppuration are unmistakable it is fair to assume that one is dealing with a staphylococcus infection and when such an abscess has been incised and drained and one finds it continues to discharge for a prolonged period this assumption becomes an assurance and when with these symptoms the radiogram reveals sequestra the assumption becomes a certainty.

From what has been said it is clear that I do not favor drilling or excavating the bones in order to search for an abscess in acute coxitis. It must be obvious that if pus is present in the joint interior or in the periarticular structures the periosteum has been penetrated and therefore an artificial opening is not required for drainage. On the other hand if pus is not present in the joint or in the surrounding tissues after the disease has existed for some length of time it must be assumed that one is dealing with a streptococcus infection and that neither pus nor a massive sequestrum is present in the bones. Hence bone drilling is not likely to be of help in insuring the diagnosis. And because it is an unnecessary mutilation in streptococcus infection and is likely to lead to an extension of the morbid condition in the staphylococcus infection it is to be strongly condemned.

In infants and very young children the differential diagnosis is difficult to determine from the objective signs alone but in them the fact that staphylococcus infections are less frequent than they are in older children and adolescents and the fact that in them the disease is much less likely to lead to such marked irreparable injury should influence not only the viewpoint of the surgeon as concerns the diagnosis but also his course of action.

Upon the basis here advocated moreover the

prognosis can be made with little of the hesitancy and sometimes without the pessimism that so often deters the surgeon from offering the patient or his relatives the consolation of a promise that although the patient is seriously ill his chances of recovery are not nearly so hopeless as the ominous symptoms that so often prevail in the earlier stages of the malady would lead one to suppose.

The evidence here presented seems so unequivocal that I can hardly believe that I have not made the subject clear. Should I have ever have failed to convince surgeons in general of the truth of the arguments I have used that the treatment here recommended for acute coxitis is the only logical one and for this reason have failed to find advocates for it I feel compelled closing to make a plea for more humanitarian handling of these patients. Nearly all the cases of acute coxitis that I see in general hospitals and in consultation in private practice are whether they are operated upon or not permitted to lie in bed and are moved sometimes roughly for the general toilet and dressings without even a simple support to the limb. The children cry out when anyone comes near the bed they shiver when the dressings are changed and are so distressed when they finally leave the hospital that sometimes months go by before they regain their mental equilibrium.

I am therefore pleading for a more intelligent and appropriate attitude toward these patients. No child suffering from a staphylococcus infection of the hip should be without a plaster spica whether a radical operation has been done or not. It takes little ingenuity and little skill to apply this support so that when at least the skin surrounding the wound if not its interior is protected by vaseline gauze the distress instead of bringing the horror that so invariably accompanies them if these simple measures are neglected is smoothly carried out without suffering to the patient. In the streptococcus forms traction is really what is required and always relieves the pain and permits of efficient handling. As these patients rarely require frequent dressings and are so readily relieved by this procedure it is hard to conceive why it should not be invariably resorted to in these conditions.

CHRONIC SUBDURAL HÆMATOMA

SIMPLE DRAINAGE AS A METHOD OF TREATMENT, REPORT OF EIGHT CASES

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OUR object in reporting this series of cases is to describe a simple method which has proved satisfactory in the treatment of chronic subdural hæmatoma.

In 1925, a complete consideration of this subject in an article by Putnam and Cushing brought this matter to the notice of the medical world and, especially, to the attention of those in neurosurgical practice. Many had seen isolated cases but few appreciated the frequency of this condition. Since 1925, many articles have appeared and several additional series of cases have been reported. The clinical and pathological findings have been described well and only need be outlined here.

We feel that our experiences warrant renewed emphasis of the following points:

1. The condition occurs at all ages, most frequently in young adults—usually males.

2. Subdural hæmatomata are relatively common and frequently follow insignificant head injuries.

3. The interval between injury and the onset of symptoms varies from a few days to many months.

4. There is no typical clinical picture. The symptoms and findings are bizarre and variable as illustrated by the occurrence of ipsilateral hemiplegia (Case 5). Papilloedema usually is present. Temporary remission of symptoms frequently occurs.

5. Early symptoms often are comparable to those ascribed to post-traumatic psychosis. Such symptoms, when followed by intracranial signs of general or local pressure or irritative phenomena, are most significant.

6. The spinal fluid pressure, when measured, is always definitely increased and, as a rule, the fluid is clear. Xanthochromic discoloration occasionally is encountered.

7. Superficial signs of head injury and X-ray evidence of skull fracture are found infrequently.

8. Frequently the condition is bilateral, in this series 50 per cent of the cases were found to be so.

9. A large percentage of cases are recognized only at autopsy.

10. Previous reports show that 83 per cent of the patients operated upon recovered.

The following case proved most interesting and

instructive, and materially changed our viewpoint as to proper ways of handling such a condition.

CASE 1. Bilateral chronic subdural hæmatoma. History of minor head injury 1 month previously. Right osteoplastic flap with removal of hæmatoma. Symptoms continued, relieved by simple drainage of subdural hæmatoma on the left side. Recovery.

D. P., German restaurant manager, aged 38 years, entered the University of California Hospital on January 31, 1927. The past history was essentially negative except for the use of several ounces of whiskey a day. On January 1, 1927, patient struck the right side of his head on a concrete floor. He was not unconscious. A headache immediately developed which gradually increased in severity. January 23, examination was reported as showing ragged and infected tonsils, right sixth nerve palsy, and staggering gait. The fundi were negative. On January 25, adenotomy was done under ether anesthesia, with delayed recovery from the anæsthetic. On the night of January 27, the patient became unconscious and extremely restless, and remained so for 4 days. On entry to the hospital, January 31, 1927, the patient was unconscious and could not be aroused, respirations were irregular. The left upper and lower extremities were moved infrequently, the deep reflexes were hyperactive on the left, with a suggestive Babinski. Pupils and extra ocular muscles were negative, the fundi showed hæmorrhagic papilloedema of 3 diopters. Blood pressure, 140-70, pulse, 100, temperature, 37.6 degrees C, respirations, 24, lungs, clear. X-ray plates of the skull were negative for any evidence of fracture. The blood count showed hæmoglobin, 95 per cent, red blood cells, 5,590,000, white blood cells, 17,600, polymorphonuclears, 83 per cent, lymphocytes, 14 per cent, transitional, 3 per cent.

Pre-operative diagnosis: possible subdural hæmatoma.

Operation: February 1, 1927, under local anesthesia, a burr opening was made in the right occipitoparietal region. The dura was tense and dark blue. On incising it, tarry, semi-clotted fluid escaped under increased pressure. A right osteoplastic flap was turned down. Before the dura could be opened, 50 cubic centimeters of hypertonic Ringer's solution was given intravenously. Beneath the dura, a typical organized chronic hæmatoma, covering the entire right hemisphere, was found and removed. The brain, however, remained tense and protuberant. Ventricular puncture yielded 5 cubic centimeters of clear fluid. Brain oedema or a subdural hæmatoma of the opposite side was suspected.

Four hours after operation, the patient suddenly developed Cheyne-Stokes respiration, with rapid pulse, blood pressure 110-65, temperature 40.8 degrees C. Lumbar puncture yielded faintly xanthochromic fluid under increased pressure. The cell count was 13. Upon withdrawal of the fluid, the respirations immediately became regular, but the patient remained stuporous. The following morning (Feb. 2, 1927) a right hemiplegia developed but his general condition remained unchanged. That afternoon, the patient again developed Cheyne-Stokes respiration, his temperature was 40.2 degrees C, pulse

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Although familiar with the frequency of bilateral hematomata over the parietal region, the necessity of exploring both sides at the first operation. In many cases the condition of the patient is such that bilateral osteoplastic peatio would be too extensive and the consumption would increase the surgical risk. Previously we have accepted the view that complete removal of the sac as well as the contents was necessary to assure a satisfactory result in view of our experience with this case we felt that small bilateral cranial openings through drainage should suffice to give temporary relief from pressure until the condition of the patient warranted more extensive measures such as a cranioplastic flap with complete removal of the hematoma sac. However, because of the absence of symptoms the procedure as considered unnecessary. The satisfactory result led us to adopt less radical surgical measures and we determined to treat subsequent cases of suspected subdural hematoma by simple drainage.

Basically the method is to make under local anesthesia 4 to 5 open incisions in the frontoparietal and petio-occipital regions of either side (Fig. 1). The incisions are so fashioned and the openings so placed that they may be incorporated in an osteoplastic flap at a subsequent date if this is necessary. Small openings made in the dura expose the surface of the hematoma. The dura is then pulled up and the contents of the sac are evacuated through and through irrigation of the sac with Ringer's solution. The scalp incisions are closed without drainage.

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l t A f t t h g h d t h g h t t h
t d t l d b b t s t 3 t m t s
f m t d Th h a m t m a t h g h t d w l
Th p t t m p m t w a m m e d t d b f
l g h p r a t g t a b l h w b l t g i d t l l t
t h d t d y m p t m Th p t t l s c
w t f t y d t f l p t f t r a t r y
p d f p h g d y f t p r a t w h u h d
f w h A t t h i s t u m t h l g l
g o y m p t m F l l w p m t r e l
p u t t b y m p t m l d g f e e g y r s f t p
C 3 U l t l h b d l h m t m f l
l w g t m 3 m t h b f t r y S m p l d r a g
R y
E A g b o o t h l a k d j n u t g e d s y r s
t e d t h p s y h p t h w r d M y 9 9 3
t p d t N h t r y w b t b l W h
d h l o o k d b t b t l d t a l k Th g h t
p p l w l g t h t h l f t b t b t t d t l g h t
M t p w l t m t w f r m l y d s e d
Th w s o m p t c i t y t h l w t m t D e p
f l w r e q l b t t g g h t h w p t h l o g l
f e s B l d p 8 7 6 p l s t m p t
h m l b l o d W m g t L m b p t
h w e d l f d p 4 m u l l m t f t
4 O p e c u b m u l l m t
O p o d f 9 d y s h d t g d t l y l r e d
d h w b l t g h h t r y f h i n g f l l 3 m t h
p t b t d h h d t b e e r l y j d
F m J 7 t J 6 t h w d f t p
f g d y m p t m d m t t t h t m
l e d t h f l l w g t h p t t w s c b t
p e r a t e Th w a m l e d p h a T d r n
l e d t h l f t t m p p t a l g t h
l g h t l g d t y b l t r a l p h i h l m g h t
t m l s q t d q l g u l p p l Th f d

showed bilateral hemorrhagic papilloedema. There was slight weakness of the right arm and of the right side of the face. The deep reflexes were sluggish but equal, with bilateral Babinski. The following day the patient was more stuporous and was unable to speak. His blood pressure was 140-90, temperature, normal, pulse, 70.

Diagnosis chronic subdural hæmatoma.

Operation June 18, 1928 the exposed dura was tense, the color was normal on the right but dark blue on the left, posteriorly. When the dura was opened anteriorly on the left, the margin of the sac was just visible. Upon rupture of the sac, old tarry, semi clotted blood escaped under pressure. The dura was then opened through the posterior burr hole and the dark blue shiny membrane lay immediately beneath. This membrane was also ruptured, allowing the escape of the same material. Through and through irrigation was then employed and many large and small blood clots were washed away. There was no evidence of fresh bleeding. The cortex, which appeared normal, was depressed from the dura a distance of 1.75 centimeters. The incisions were closed without drainage.

Immediate improvement was noted. Convalescence was slow but steady. At the time of discharge, 27 days after operation, the patient was up and about. He was free from symptoms and the eyegrounds had returned almost to normal. We have been unable to follow this patient's progress.

CASE 4 Unilateral subdural hæmatoma following minor head injury 10 days before entry. Simple drainage. Recovery.

A. W., American, truck driver, aged 40 years, entered the San Francisco Hospital July 14, 1928. The past history was essentially negative, he used alcohol in moderation. On July 3, 1928, the patient was struck in the right parietal region, receiving a small scalp laceration. He was not unconscious. On July 5, he first complained of slight frontal headache and dizziness, but returned to work. One week after injury, his headache became more severe and at times he was mentally confused. He remained at home for 4 days, during which time he became progressively worse.

On admission to the hospital, he was semi comatose, extremely restless, mentally confused, and was yawning continually. When aroused, he answered questions slowly. There was no speech difficulty. His face was expressionless. There was bilateral ptosis of the eyelids, greater on the left. The eyes showed a tendency to deviate to the left, the left pupil was irregular and larger than the right, both reacted sluggishly to light, there was a right external squint. The fundi showed early papilloedema without hemorrhage. There was no weakness of the extremities. The deep reflexes were equal with the exception of the right patellar which was hyperactive, Gordon and Oppenheim, positive bilaterally, Babinski negative. Roentgen rays of the skull were negative for fracture. Blood pressure was 130-90, pulse, 60, temperature, 37 degrees C, blood count was within normal limits, blood Wassermann was negative. Lumbar puncture revealed fluid, clear, pressure, 500 millimeters of water. One cubic centimeter of spinal fluid was removed, cell count, 20 lymphocytes per cubic millimeter.

Diagnosis chronic subdural hæmatoma.

July 16, 1928, lumbar puncture pressure, 750 millimeters of water. Fifteen cubic centimeters of clear fluid was removed. The following day the patient was less stuporous, but had difficulty in naming objects, there was no stereognostic disturbance. His pulse rate was slowing.

Operation July 18, 1928. The meninges and cortex appeared normal on the left. The dura exposed on the right side was dark blue and, when incised, the dark bluish

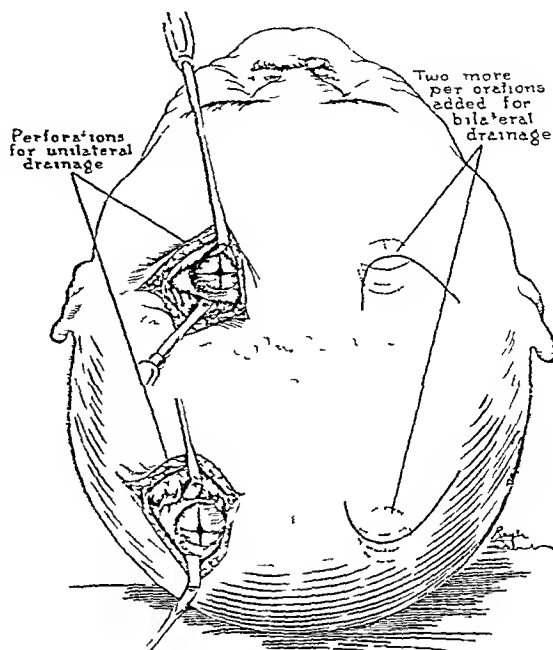


Fig. 1 Position of head at operation showing the relative locations of the trephine openings as used in the bilateral exploration of chronic subdural hæmatomata. Curved black lines (right) show the type of incision used.

membrane of the hæmatoma tended to herniate through the dural openings. The membrane, which was about 1 millimeter in thickness, was torn open thus allowing the tarry liquid and small clots to escape. The cavity was irrigated through and through with Ringer's solution. There was no evidence of fresh bleeding. The cortex, depressed 2 centimeters, was of normal color, but the veins appeared congested. The scalp incisions were closed without drainage. Immediate improvement was noted.

The postoperative course was uneventful. The patient was discharged from the hospital 22 days after operation and returned to work in 2 months. At the present time (February, 1931) he is well except for an occasional mild headache and slight vertigo on stooping over.

CASE 5 Unilateral chronic subdural hæmatoma with onset of symptoms 4 months after a severe head injury, ipsilateral signs, ventriculography. Simple drainage. Recovery.

J. C., Chilean, sailor, aged 30 years, entered the hospital on December 14, 1928. The past history was essentially negative. On September 7, 1928, he received a severe blow on the back of his head, on the left side. He was unconscious for 24 hours, bled from his ears and nose, and vomited repeatedly. Both upper and lower eyelids were ecchymotic. He returned to work the latter part of September, 1928, but continued to have spells of generalized headache and vertigo.

On December 12, 1928, during a quarrel, he was struck on the left temporal region and, shortly afterward he became dizzy and fainted. Examination was made on December 14, 1928. Patient complained of slight headache. Pressure in the left occipital region was somewhat painful. The pupils were contracted, equal, reacted to light, the fundi were not examined. The deep reflexes were normal.



Fig 3 Same as Figure 2, lateral view of left lateral ventricle showing uniform compression and decrease in size (Case 5)

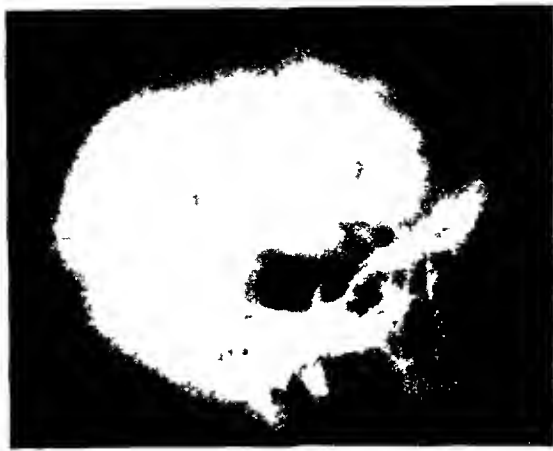


Fig 4 Same as Figure 2, lateral view of right lateral ventricle (Case 5)

our opinion, the value of simple drainage in these cases. No autopsy was obtained and it is impossible to say whether or not there was continued bleeding. The low spinal fluid pressure indicated that the increased intracranial pressure had been relieved. It is our impression that death was caused by the prolonged intracranial pressure followed by cerebral anæmia and œdema after operation, aggravated by pneumonia.

CASE 7 Bilateral chronic subdural hæmatoma following severe blow on the chin 6 weeks before entry to the hospital. Simple drainage. Recovery.

C K, Australian, engineer and garage foreman, aged 45 years. The past history was essentially negative. On June 29, 1929, the patient was struck forcibly on the chin by the handle of an automobile jack which slipped. He was unconscious for half an hour. For the next 2 days he suffered severe headache, bad flashes of light before his eyes, blurred vision, diplopia, and tinnitus aurium, left. This cleared and for a few days he felt fairly well and was up and about. During the next few weeks he had an occasional bout of severe vertigo and projectile vomiting. Four weeks after the injury, the headache and vertigo became so severe that he was taken to the hospital. He remained in bed 6 days and felt improved. He was then allowed to sit up. For the first time he complained of difficulty in speech and, on attempting to walk, was aware of a peculiar sensation in the fingers of the right hand, which suddenly began to twitch. This was associated with a peculiar feeling in the left side of the face and blindness of the left eye. He felt faint, he was put to bed and gradually became stuporous.

On August 7, 1929, examination was made by a neurologic surgeon who reported patient stuporous and difficult to arouse. Deep pressure elicited tenderness in the left subtemporal region. Pupils were equal and reacted to light. Fundi showed bilateral papilloœdema without hemorrhage. There were right hemiparesis and hemihypesthesia of face, arm, and leg. The deep reflexes were more active on the right, Babinski was positive on the right, non sustained ankle clonus on the right. X ray examination of the

skull was negative for fracture. Blood Wassermann was negative. Spinal puncture revealed pressure, 800 millimeters of water, fluid, clear, cell count, 8, Wassermann, negative.

Diagnosis chronic subdural hæmatoma.

Operation August 8, 1929. The dura, exposed on the left, was dark blue and tense. It was thicker than normal and, when incised, the bluish sac of a subdural hæmatoma was exposed and ruptured, thus allowing the contents to escape. The cortex was depressed 1.5 centimeters from the dura. A similar procedure was carried out on the right side of the head, with identical findings. Both sacs were irrigated with Ringer's solution. The hæmatoma on the right side was not so large as that on the left. The incisions were closed without drainage. The patient recovered consciousness immediately and said that his headache had disappeared entirely.

All of his symptoms did not clear and 5 months later he was still complaining of vertigo, slight generalized headaches aggravated by stooping over, and tinnitus aurium left. The patient was readmitted to the hospital on January 3, 1930, on account of the persistence of the foregoing complaints. Examination was entirely negative except for diminished hearing in the left ear. Lumbar puncture was made and showed pressure 120 millimeters of water, fluid, clear, 125 cubic centimeters of air were injected. The X ray examinations made showed the ventricles to be of normal size and symmetrically placed. The subarachnoid air was uniformly distributed.

Following this procedure the patient has shown definite improvement, but has continued to have mild attacks of vertigo and tinnitus in the left ear. At times these symptoms are severe and are associated with nausea and vomiting. At no time does he have headache. He is now doing light work.

This is the only patient in our series with continued symptoms. His complaints are those common after head injuries, but seldom are patients so free from headaches. That this is an industrial compensation case may be of significance.

The questions arise in this case: is the remaining sac of the hæmatoma responsible for the present

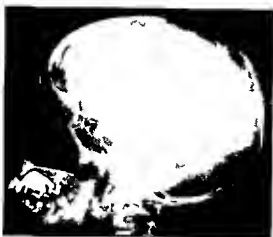


Fig 5 X y p l t f k l l a t l w h u n g
l t d p l g l d (C 8)



I 6 A t p t n w h w t h p n l g l d
h f t d t t h l f t (C 8)

sympt ms? If s e p l r a t o n v a r r a n t e d b y
m e a n s o f a n o s t e o p l a s t i c f l a p?

C 8 U l t l h h d l h a m t m f l l
g m a h d j r y g w k p l y P l h f t
S m p l d g R r y
P P E g l h t g d s s y r s T h p t h a t r y
O S p t m h 6 9 9 t h p t t b m p d h h d
f h l y t h g h t p t l g H w m m t l y
t d b t t d t h f t O w k f t h
J r y t t d l r i g h t d d h d h d l p d
T h w s e t t m t d w i t h d
m u t g d w g g r a t d b y t p g T h
d w k t h m p m t p f l h t
t i f f m h k T h p i t t d t k t l
N m h 4 t h g h h w t b l d b y t t h d
h m k d g l i z d w k d d i f f l y
m m h n g h l N s e w t t d h
m u t e d l t m w i t h l f
O N m h 6 9 t h p t t w f t b y
p h y H w p l w k m t d b l t
t t d h u m m r y w p O t h r w t h
m u t t l l y g t X y m u t
f t h h d h w d t h p l g l d t b h f t d s m l l
m i t r t t h l f t h m d l (F 5 6) t h
d f f t B l d p w o s p l 7
t m p r a t 37 d g C b l o o d W r m g t
b l o o d h m t r y m l B l o o d t h a m g l b 94 p
t e d b l d l l 49 s o o h t b l o o d l l 6
p l v m r p h l 83 p t l y m p h y t 4 p t
t t l 3 p t
O N m b e 8 t h d l p d l g h t t d
t h r i g h t d f t h h d g h t h m p d h m
h y p a s t h a f f r m d l g T h d e p f l w
m t t t h l f t t h f t l d m l f l w
b t t h w t e d n k l l d g g t
B b k s d O p p h u m f l e s t h l f t T h f d
h w d l y p l l o r d m a w i t h t h a m h g H n g
w m p d b l a t l l y m t h l f t l m b p
t h w e d p 38 m u l t m t f w t f l d l e a
l l t h m a t r y g t

D g t h t s d y t h p t t b c a m d t d
t t m h w b l t f d h m s l f d t d r y
Q l y
g h t h m u p h h d l l a m t m l t h
O p t N m b s g o t h d t h r i g h t
t d d k b l U p i n g t h h y d k b l
s a f t h a m t m a t d e d t p t r u d t h h t h d r u l
p i n g T h s a w a t r n p t h l l w g t h
p f u t t t w h h d p d w
g t d d t h g h d t h g h w i t h R g l t
T h l p w l e d w i t h t d g S h
e q t d t h y p l t h d t h p l g l d t b t
g g d l y t t m d l p t
T h p t t m d p d r y t h t h p t
t h t t h t h d d y f t p t h h d l
h l l t H d h d f m t h h p a l
w l l 3 w k f t p t l h m u n e d t t h
p t t u m t m p t h s l c u p t

T h e u l l t a t e s t h e v a l u e o f t h e p n e a l s h f t
(1) I n v f t h e f a c t t h a t t h e p i n e a l d s p l a e
m e n t a d t h l a l n s w e i n a r e e m e n t w e
f e l t t h a t l t l e p l a t i o n a s i n o r d T h e
p o m p t r e c o v y f t h p a t e t m a d e f u t h e r
p l o a t o n u n a v

DISCUSSION

O t h e r r i t p t i c l a l y R a n d () h e s
g e s t e d t h m d h e d m e t h o d s m i g h t g e s t s
f a c t o r y r u l t b u t a s f a r a s e l n w n o n e h a s
r e p o r t d a e t e s o f c a s s t e t d

A f n y q u e s t o t a l l y a e w h e n c o n d e
g t h a d v i s a b i l i t y f e m p l o y i n s m p l d a
g W h a t t h e p o s s i b i l i t y o f m m d a t e r
d e l a y e d h a m h a g e? D t h m a u g p a t h o
l o g i c a l t u e p e r s t m d m a y i t p e t o b e h a m
f u l? I f s o v h a t f t u e c o m p l c a t o s m y r e s u l t?

Inasmuch as complete surgical removal of the type of hæmatoma under consideration is possible and incomplete removal of pathological material is not an accepted surgical principle, we feel that the method of simple drainage is open to criticism. Nevertheless, we urge these advantages in its favor

1 A relatively minor procedure is substituted for a formidable operation

2 Exploration anteriorly and posteriorly, as described, minimizes the possibility of overlooking such a condition which, in a certain percentage of cases is bilateral

3 A negative bilateral exploration can be followed at once by the diagnostic procedure of injecting air into the ventricular system

4 Local anæsthesia can be employed invariably

5 The time which is required for the operation and the tax on the patient are reduced to a minimum

The number of cases so treated is few and the time elapsed since the method was first used has not been sufficient to allow us to make an unqualified statement as to its worth. However, we feel that the immediate and remote results warrant its continued use in place of the accepted and more radical procedures

SUMMARY AND CONCLUSIONS

1 Non-operative treatment of these patients has proved unsatisfactory

2 Exploration through small trephine openings is a benign procedure and is indicated in suspected cases of chronic subdural hæmatoma

3 Evacuation of the hæmatomata through small openings is efficacious

4 In no instance has there been a recurrence of symptoms. Four years have elapsed since we first used this method of treatment

5 In this series of 8 cases only 1 patient died, this patient was *in extremis* at the time of operation, and we feel that his death should not negate the value of the method of operation. Six, 2 of whom had bilateral hæmatomata, are entirely well. One patient with bilateral hæmatomata complains of constant tinnitus and occasional attacks of nausea and vomiting. This is an industrial case and compensation neurosis may play some part. His symptoms are those commonly found with head injuries and may bear no relation to the subdural hæmatomata

6 The pineal shift is of diagnostic value in this condition as well as in cerebral neoplasms

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Fig 5 V y p l t f kull l t r a l w h g
l n d p l g d (C 8)

symptom? If so, exploration warranted by means of an osteoplastic flap.

C 8 U l t r a l h b d l h a m t m f l w
g m u b d j r y 9 w e e k p l y P l h i s t
S m p l d g R r v
P R E g h t g d 5 5 j T h p l h t r y
w a g t p t f f e q t l k o f f z a
O n S e p t m b 6 9 0 t h p t t b m p e d h h d
f b l y t h g h t p t l g H m m t l y
t e d b t t e d t h f t O w k f t t h
j r y t a t d l l g h l d e d h d l p e d
T h w s e t u m s o c t e d w i t h
m t g d w g g t d b y p g T h
e c d w k t h a m p m t p t f l i g h t
t i f f u n h k T h p t n t d t w k t l
m b 4 t h g h t b l d b y n t t h d
h m k d g l d w k d d f l t y
m m b g h l N t t d h
m t d l t m w t h l f
O N m b 6 9 0 t h p t t w 6 t b y
p h y c i H w p l w k m t d b l t
t r a t d h u m r y w p O t h w t h
m u t w t l l y g t N r a y m t
f t h h d w e d t h p l g l t b h f t d 5 m l l
m t t t h l f t f t m d l (F g s 5 6) t h
d f f t B l o o d p w o 8 p l 7
t m p e t 3 7 d g C b l i W m a g t
b l o d h m t r y m l B l o o d t h m g l b 9 4 p
t d b l d l l 4 9 5 o o h t b l o o d l l 6
p o l y m r p h l r s 8 3 p t l y m p h c y t 4 p t
t r a t t l 3 p e t
O N m b 8 t h d l p e d l i g h t d m
t h g h t d f t h h d g h t h m p d h m u
h y p e r s t h a f f r m d l e g T h d p f f w r e
m t t t l f t t h l f t b d m l f f w
b s e t t h w t e d k l l d g g t
B b k d O p p e h u m f l e s t h l f t T h f d
h w e d l y p a p l l o r d m w i t h t h a m h g f f g
h a m p a u e d b i t r a l l y m t h l f t L m b p
t h w e d p e s r e 3 8 0 m u l t i r s f w t f d l e a
l l u n t c h m u t r y g t u



Fig 6 A t p t m w h w g t h p l g l d
h f t d t h l f t (C a 8)

D u n g t h t 3 d y t h p a t t b e m d t e d
l t u m h w n a b l t f e e d h m l f d t e d r v
Q u a l y
D i a g n h b d r a l h m t m l g t h
h t h m u s p h r e
O p e r t m b s 9 0 0 t h d r a t b g h t
t d d a k b l U p o n g t t h h y d k b l
s a f t h h a m t m t d e d t p r o t r u d t h g h t d r a l
p u n g T h s a w t m p e t h l l w g t h
s c p e f t h t s w b b w d p e s r e d w
n e a t e d t h g h d t h g h w i t h R g l t
T h s c a l p m w c l s e d w i t h t d g S b
e q u e n t N r a y p l t h w e d t h p e a l g l d t b t m
g r a d l l y c t m d l p o s t
T h p t t m d r a p d r y w i t h t h p t
t h t t h t h d d y f t p t h h d d
h l l o H d b g d f m t h h p t l
w l l j w l a f t p t d h m d s o t t h
p t i m t g h l p t

This case illustrates the value of the pineal shift
() In view of the fact that the pineal displacement and the clinical signs were in agreement, we felt that unilateral exploration was in order. The prompt recovery of the patient made further exploration unnecessary.

DISCUSSION

Other writers particularly Rand (3) have suggested that modified methods might give satisfactory results but few have reported a series of cases so treated.

Many questions naturally arise when considering the advisability of employing simple drainage. What is the possibility of immediate or delayed hemorrhage? Deslith remaining pathological tissue persisting and may it prove to be harmful? If so, what further complications may result?

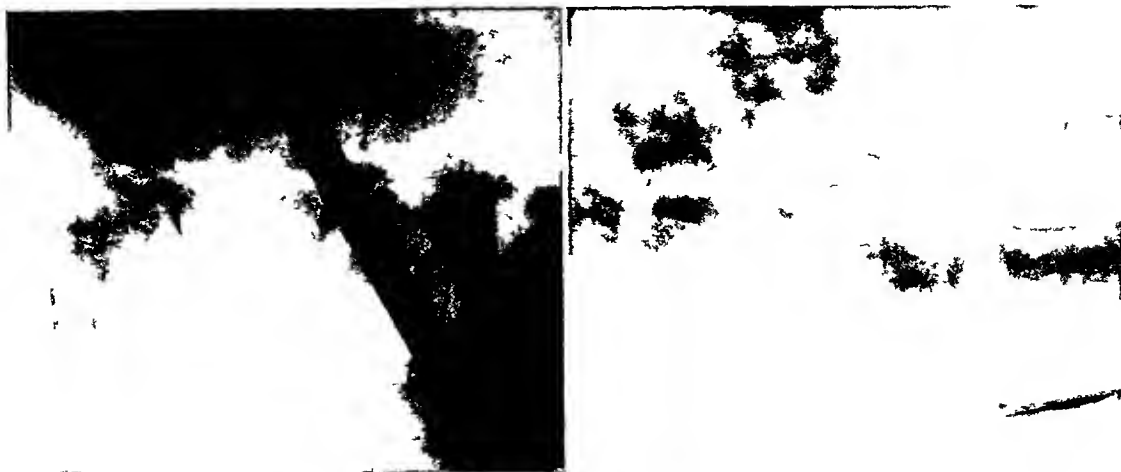


Fig 1 A and B Unilateral dislocation reduced, but an exaggeration of primary position would be preferable to avoid intimate contact present between the femoral head and the upper acetabular margin Flexion should be accentuated

can be imparted to the mal-developed head and acetabulum. With this thought in mind, the spica is applied so that it does not extend too high upon the chest and save in rare instances not below the knee. The spica should be accurately molded to the pelvic crests, and should reach no higher than the free margins of the ribs. Abduction of the thigh should never be carried out behind the frontal plane of the body, lest we induce an anterior luxation. The extent of flexion should be determined by the stability of the primary reduction. If, upon reduction, the superior and posterior rims of the acetabulum have been found to be unusually shallow, it is advisable to accentuate the flexion of the thigh in order to withdraw the head from the superior acetabular margin. This accentuated position is sometimes known as the axillary or Werndorff position. In the ordinary case, however, rectangular flexion is sufficient and is to be preferred. There is little doubt that the primary position is seldom actually maintained in the average bandage, and only too often does the X-ray picture show a thigh partially extended with the head of the femur, resting in close contact with the superior border of the acetabulum. Any such bandage should most certainly be immediately rectified, because the acetabulum is not prone to develop in the presence of this intimate contact between the acetabular margin and the femoral head.

In regard to the knee, the consideration of function is most important. Many operators are in the habit of including the knee in the congenital hip spica. This inclusion is seldom necessary and in most cases not desirable. In the first place, the

constant maintenance of rectangular flexion of the knee favors contracture of the hamstring muscles, and the subsequent undue tension of these muscles when the leg is eventually extended upon the thigh at the conclusion of treatment, produces a force which may tend to cause a re-luxation. Indeed, it is most desirable at the time of operation thoroughly to stretch the hamstring muscles, and during the course of after-treatment while the child is in the primary spica to maintain the capacity to extend the leg fully upon the thigh, through the medium of active and passive exercises. If the knee has been included in the spica, such exercises cannot be carried out, and in addition it is difficult for these children to walk in such a spica in which the knee has been included.

The question of permitting weight-bearing function of the reduced extremity while still in the primary bandage, is one about which there is a rather wide diversity of opinion, and perhaps a large number of failures can be attributed to the omission of this very important feature in the treatment. After the original reduction, and after it has been ascertained by X-ray examination that the femur has been thoroughly reduced, the child should be permitted to remain in bed for a period of from 3 to 4 weeks. During this period the parents must learn the principles of the adequate protection of the spica from soiling by urine and feces. This can best be done by instructing the parents to draw flannel diapers through the cast posteriorly and thoroughly to diaper the pubic and perineal margins of the cast. In addition to this protection I have been accustomed to varnish the surface of the spica after it

CONGENITAL DISLOCATION OF THE HIP

WITH SPECIAL CONSIDERATION OF AFTER TREATMENT FOLLOWING CLOSED REDUCTION

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A. A. and Or. h. p. d. S. H. IT. J. D. A. O. h. p. d. g. L. H. H. I.

ORTHOPEDIC literature in recent years particularly that emanating from American sources has been extremely pessimistic in regard to the end results of the closed reduction of congenital dislocations of the hip. Although from a number of foreign sources we have comparatively favorable reports, it would seem that many of our representative American orthopedic institutions are tending more and more toward favoring various open procedures for the alleviation of this condition. It is hard to reconcile such wide variations in results as reported by operators as competent as Putti and Lorenz abroad with the thoroughly unsatisfactory results reported in this country.

The reduction of a congenital dislocation of the hip by the closed method is an operative procedure which requires considerable experience before it is thoroughly mastered in all of its details. The operation is not the more less traumatic manipulative procedure as commonly pictured; in fact, the maneuvers must all be carried out gently and without the exertion of more force than is absolutely necessary to effect the reduction. The tendency of the physical structures of the head of the femur and of the acetabulum are seriously injured by ill directed and violent forces falling upon these structures. Injury to the ligaments of the femoral head and of the acetabulum leads eventually to malformation of those structures and gradual development of luxation and incapacitating dystrophies of the hip.

In performing the reduction, the anatomical and physiological considerations must be kept in mind. We are not only attempting to place the head of the femur in the acetabular area, but we are endeavoring to create circumstances conducive to the proper development of the ball and socket configuration of the normal joint. The main factor producing instability of the reduced joint is the shallowness of the acetabulum and unless we can create conditions which will favor the development of the acetabular socket we can never hope to secure a stable articulation. In the growth of the acetabulum, the most important single factor is the development of the upper and posterior margins of that structure. We must so reduce and maintain the femoral head as to avoid

any direct contact between the head and these important margins of the acetabulum. The ideal position of reduction is that in which the head of the femur is withdrawn as far as possible from the superior posterior margin of the socket while still remaining well within the acetabulum; that is, the head should be reduced into the anterior inferior acetabular area. The accompanying X-ray films (Figure A and B) illustrate hips

which have been considered properly reduced by competent operators. Some of the films show contact of the head and the superior acetabular margin which if continued would surely prevent the development of the upper roof of the joint. In the film in which proper reduction is exhibited it will be noted that the intimacy of the contact is avoided and that any mechanical hindrance against the outward development of the acetabular roof is obviated. In this position of the capsular pull favors the outward growth of the bone to which it is attached at the upper margin of the joint (Figs. 3 and 4).

In any type of plaster of Paris bandage which is applied after the reduction of a congenital dislocation of the hip, support of the after cast. The general plaster bandage should be designed as far as possible to last throughout the primary period of immobilization. In applying the congenital hip splint, several important features in design should be kept in mind. It is absolutely essential that the plaster should be permeable to the X-ray particularly in the area of the hip joint; otherwise clear visual attention of the reduction will be impossible. It will be eliminated from the preceding discussion concerning the relationship between the head and the position of the acetabulum that the essential thing is a good X-ray film should be obtainable after plastering. The use of metal or fiberglass casts commonly employed in some clinics often defeats this prerequisite (Fig. 6). The application of too heavy a plaster cast or the attempt to radiograph the joint under a plaster bandage will also impair the X-ray film of the reduction.

It is desirable that the reduced extremity be positioned in flexion throughout the major portion of the immobilization; that is, the thigh should be in flexion to the hip joint.



Fig 6

Fig 6 Bilateral congenital dislocation of the hips. The introduction of an opaque bar in the re-enforcement of the spica obscures the details of the reduction and makes an accurate diagnosis impossible. This case was pronounced reduced on the basis of the X-ray, but this assumption is unwarranted.

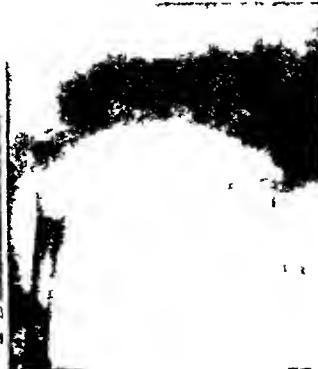


Fig 7

Fig 7 Unilateral dislocation, in which an attempt was



Fig 8

made to correct the primary position into a secondary position. It will be noted that re-dislocation has occurred.

Fig 8 Unilateral dislocation showing the effect of the impingement of the femoral head upon the upper acetabular margin. Under the influence of this continued pressure, the tendency for acetabular development is very seriously impeded.

even to run, encumbered as they are by awkward spicas. Even patients with a double dislocation are able to learn to walk in the frog position.

The use of the extremity as outlined accomplishes a number of desirable things. It insures a healthy muscular development of the extremity, so that in place of atrophic and flabby musculature resulting from long cast confinement and inactivity, these children develop excellent tone in the muscular and ligamentous structures of the extremity. The function also prevents bony atrophy of disuse, and, if we are to place any confidence in the soundness of Wolff's law, also favors the development of the internal architecture of the femur and acetabulum along sound mechanical and architectural lines. It is not that the head of the femur is pounded into the acetabulum, as stated by many observers, but rather that stimulus is provided through use, affecting favorably the bony configuration and constitution of pelvis and femur. This element is an outstanding feature in the proper handling of these cases.

The congenital hip spica should be changed as infrequently as possible during the course of cast confinement. The frequent changing of the spica engenders re-dislocation, due to inadvertent manipulations of the extremity during the removal of the old spica and re-application of the new one. In any case, when the necessity for renewing the spica presents itself, it is best to carry out both removal and replacement of the spica under anesthesia. If the spica has been well applied and if the parents are properly advised in regard to the protection of the spica and carry out such advice,

renewal of the bandage will be an infrequent necessity.

In the average case, it is undesirable to resort to any but the primary position during the course of treatment. The use of secondary and tertiary positions, as formerly recommended, is to be avoided. This point should be emphasized. The entire course of treatment is carried out by means of only one position, that of the primary position of reduction. It is true that under certain circumstances this principle must be altered. Most important of these exceptions is the case of ante-torsion of the head and neck of the femur, in the presence of which complication it is often desirable, after primary reduction, to apply a second spica in partial extension and exaggerated internal rotation of the thigh (Fig 7).

During confinement in the spica X-ray pictures of the hip should be taken at intervals of 6 to 8 weeks. These films enable one to follow the progress of the development of the acetabulum, which is the most important single criterion by which the eventual stability of the reduction can be ascertained. If it is seen at any time during the course of treatment that the head is resting in close proximity to the superior acetabular margin, then the spica should be taken off, and the position so altered as to remove the head from this margin.

The duration of confinement in the primary position will vary to some extent according to the individual case. It is seldom, if ever, wise to make this confinement less than 6 months, and usually it is safer to overestimate the length of time, and



F



Fig 3



F 4



Fig 5

Figs 3 & 4. U l t l d i s l o c a t t a s
f t u m t t t h w t h d w l f t h h d f m t h
p t b l m g t h g h t t m t f g
4 w t a k m m d i a t l y f t f l m l f t h p

d F g u s w t k p p r o m a t l y y r s f t t h
m p l t f t h t e a t m t N t e s p l l y t h d t
p m t f t h p h l f f t h a c t b l m w h h
t a k p l

has th roughly d r e d A c a t f w h i t e D u
w h i c h i s a r a p d l y d r y i n g e a m e l l i k e p a i n t a
r t h r e x c e l l e n t w a t e r p r o o f i d s i n g

A t t h e e n d f 3 o r 4 w e k s i n a l l c a s e s e p t
t h o s e n t h e v a g g r a t e d p m a r y p o i t i o t h e
c h i l d h u l d b p r o i d e d t h a p a i r o f h o e t h e
s h o e u p t h e r e l c e d s i d b e n g s o a l t e d s t o
c o m p e n s a t e a p p r o m a t e l y f r t h e s h t e n g p r o
d u c e d b y t h e a b d u c t e d f l e p o s t n f t h e c
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s h o u l d n o t w h o l l y e q u a l t h e l e n g t h o f t h e

e t r e m u t y a t h e r e s h o u l d b e s o m e p e l v c t l t
t w a r d t h d s l o c a t e d s i d e u p n w a l k n g T h e
c m p e n a t n c a n b e s t b e m a d e b y a t h i c k c o k
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t l t h e p a c i t y f o r m a i n t a i n g b a l n h a
b e e n a c h v e d I t m a k b l e h v q c k l y
t h e c h i l d r e n a c q t h e c a p c t y t o w l k a n d

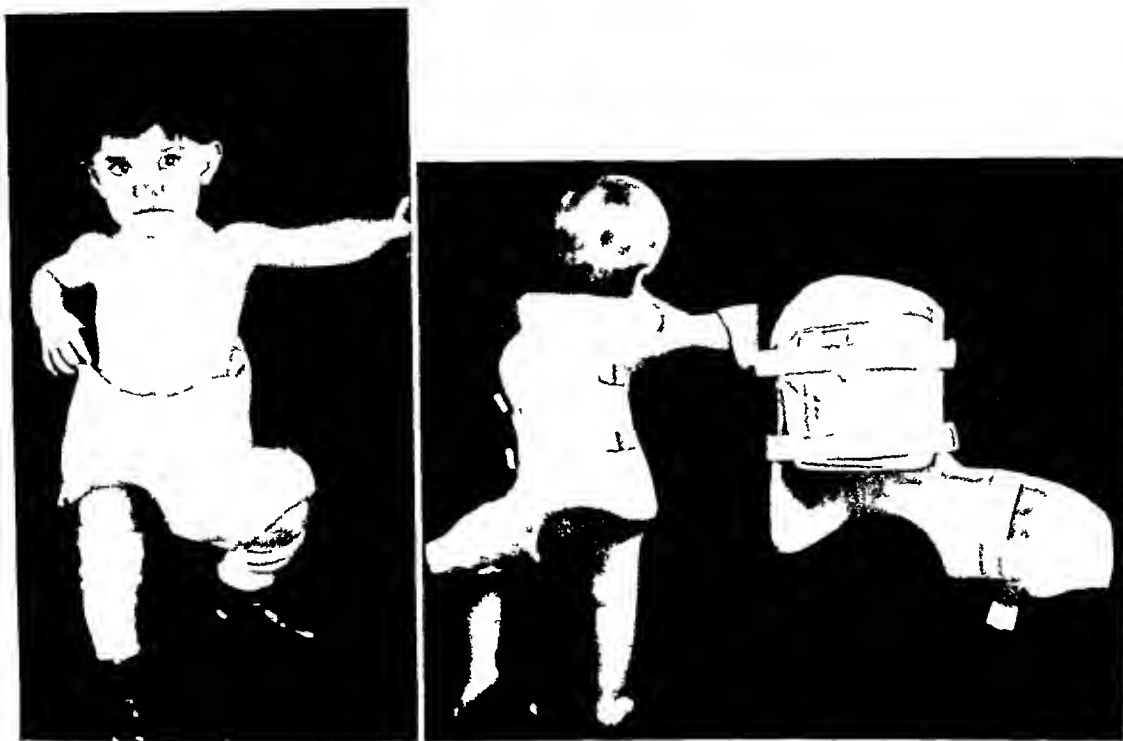


Fig 11 (left) Unilateral dislocation illustrating use of raised shoe with cork sole in order to permit walking in the primary position during the course of treatment

Fig 12 Plaster night shell used in the after care in order

to re establish the primary position at night The child is photographed in the standing position, so as to show the construction of the under surface of the shell, which is flattened in order to prevent rolling

of the shell, so that the child can be secured in position, when placed therein. Of course, it is not necessary to elaborate the shell beyond placing a lining of sheet wadding therein, and in such a bed the child can be bandaged each night. The principle, however, which should be emphasized, is the necessity of re-establishing the primary position each night over a period which can most safely be estimated at a year from the time of the final removal of the plaster spica. This accomplishes several desirable things. It prevents the recurrence of muscular contractures, which would tend to produce re-luxation. It returns the head of the femur to the depths of the acetabulum for a period ranging from 8 to 12 hours daily, and thus favors a continuation of acetabular development, and by maintaining abduction and flexion, it prevents a too rapid correction of this position, which is most favorable to stability. There are other ways of maintaining this position at night, as for instance by means of a brace or by means of a split spica. However, the plaster shell is the least expensive, most comfortable, most controllable of devices.

A simple form of exercise is indicated in order to re-establish the muscular sufficiency of the reduced joint. Simplicity is desirable in order to enable the mother or a reasonably intelligent untrained nurse to supervise and control the exercises. We should be principally concerned with the development of the pelvi-trochanteric muscles, and at the same time aim actively to maintain the adductors and hamstrings in a functionally sufficient but thoroughly uncontracted condition. It must again be emphasized that abduction and abductibility favor stability, and for this reason we should devote the major attention to the development of the abductors of the thigh.

The exercises are best begun with the child lying upon its back, and active abduction is encouraged with only the frictional resistance of the surface upon which the extremity is lying. In very young children this active exercise may have to be stimulated by tickling the sole of the foot or gently prodding it with a pin. As the strength of the abductors increases, slight resistance should be made with the hand in order to increase the



Fig 9

Fig 9. Red ed blat ral d locat. U trating th
post with th bd ted thgh fl ed somewh t bo
ght gl N t th f l lk trip d t protect
th ca t f m sol g by d fæ es
F U l t al dialoc t f th h p b f th t

Fig

ha b f lly finished N t th l w cutting f th pla t
th p g t m Th permits bd m l esp rat rv
m me t d p t t f with th d gesti
Processes th gh th p es f th ca t po th bd m
l ra N t l th t th k f

to keep even the favorable cases in the primary
sp ca for a period of from 7 to 8 months. It was
formerly the universal custom to place the e
tremity in a second ry pos t n n a plaster spica
by h ch the abduction and fle ion ere pa tally
reduced. It is my experience that this is an
undesirable pro du e e cept n cases in which
some c mplicating factor su h as antet rs n of
the head necessitates a secondary plaste nter
al rotation. For the most part after the p d
of p mary immobil ation has been passed a d
redu t on is evidently stable n this position the
spica sh ld be remo ed a d the child may be
permitted to w lk upon the e t em ty wear n in
the case of unilateral dislocat on the raised shoe
h h has already been described. With this shoe
the ch ld ll w lk initially in an att t de re
embl n the p m y position ll st ted in
the accompany ph tograph (Fig) We now
so t t a method of gradual aut m tic c ection
of the flexion d abd cti n of the thigh instead
f any f rctible rre t n of the t remity t pa al
lism. The raised sole of tl h e is gradually
l mshed in h ght f m w ek to week e
qua ter f an in h bei g remo d from th le a
t on e ery w ek o 10 days. Thus the ch ld ll
very gradually bri g the extr mity d n from the

fle ed pos t on and at the same time as the ad
ductor muscles g n t ne w ll ca ry the th g
m re and more to a d the m dl ne. By this ery
s mple e ped ent an automat c correction of the
fle ed d abd cted thigh is accomplished.

At the time hen the spica is finally remo ed
a plaster shell is molded to serve as a ight spl t
in which the primary pos t n is re establ shed
d r gs ch times as the ch ld may be recumbent.
The p pa ation f th s plast shell is s mple.
The ch ld is placed upon its face w th the red d
thigh n the primary position. The skin of the
back and of the thigh is ell powdered with tal
cum a d a pla te shell is modelled by smooth
laying success e layers of plaste bandages from
the level of the a ilæ including the th gh t th
knee. This shell well re enforc d and is bu lt p
t a th ck es v h ch v ll insu ample stab lty.
When the plaster has dried it is moved from th
child nd after the edges h been trimmed
d n d bevelled t s padd d with a thin laye
of felt wh ch is b e t gl d t the in e surface of
the pl ter. It des able but not necessary t
pl the shell n a wooden cradl e y muc
h p model placed i a dl so that it w ll
al ay t pon an n keel Fabric atps and
buckl t correspond can be riveted t the edges

PRIMARY ADENOCARCINOMA ARISING IN A MECKEL'S DIVERTICULUM

PAUL MICHAEL, M D , AND H GLENN BELL, M D , SAN FRANCISCO

From the Departments of Pathology and Surgery of the University of California Medical School San Francisco

EVER since Meckel the younger described a diverticulum of the lower ileum in 1809, the medical literature has contained many articles describing this structure and its anomalies. The actual incidence of Meckel's diverticulum has been estimated to range from 1 per cent to 3 per cent of all individuals. Christie, in a very excellent review, ascertained the percentage to be approximately 1.1 per cent, and he gives the sex incidence as 75 per cent in males and 25 per cent in females. Harbin, in a less extensive series, determined that 35 per cent only were found in males and 65 per cent were found in females. Christie's figures are probably more accurate.

By far the greater number of complications have occurred in males. Cannon reported a double intussusception caused by Meckel's diverticulum, Coley described a diverticulum complicated by tuberculosis, McCalla cited a case of perforated "peptic ulcer" of Meckel's diverticulum. These complications are by no means isolated—they are merely examples of many kindred conditions. Though the foregoing complications are not uncommon, malignant neoplasms of Meckel's diverticulum are seen very rarely.

Many years elapsed between the original description of the diverticulum by Meckel and the first authentically reported case of malignant leiomyosarcoma by Fried, in 1902. Kaufman, in 1911, reported that, in the Basle collection, there existed a case of a spindle cell sarcoma of Meckel's diverticulum occurring in a woman 72 years of age. Later in the same year, Tschunkowerow described a case in which, at autopsy, a malignant spindle cell sarcoma was found in a woman 62 years of age. Haessner, in 1913, cited a malignant tumor adherent to and including a Meckel's diverticulum. This was probably also a spindle cell sarcoma and was in an advanced stage of degeneration. Douglas Symmers, in 1919, reported the second case of a malignant leiomyosarcoma, occurring in a male 22 years old. This tumor was found as an incidental feature in the course of an operation for hernia and apparently gave no symptoms. Black also in 1919, made mention of a potentially malignant papillomatous growth arising in a diverticulum in the sigmoid region. The inclusion of this tumor as a neoplasm of

Meckel's diverticulum has been questioned by most authors. In 1925, Crile reviewed the literature and added a case of spindle cell sarcoma occurring in a woman 41 years of age. This tumor was removed and the patient given a full course of deep X-ray therapy. One year later she gave no evidence of subsequent involvement or metastases. Mathews, in the same year, reported a very interesting case of a myoma, arising in Meckel's diverticulum, which was removed at operation in a woman 44 years old. Five years later the patient returned with a recurrence of the tumor and considerable pelvic involvement, histologically a malignant leiomyosarcoma. The first carcinoid tumor of Meckel's diverticulum was reported by Hicks and Kadinsky in 1922, this occurred in a boy 12 years old. In 1926, Stewart and Taylor noted a carcinoid tumor arising at the tip of a Meckel's diverticulum in a male patient 54 years of age. After careful examination of material from Hicks' and Kadinsky's patient, Stewart and Taylor questioned the correctness of the diagnosis of carcinoid tumor in this first case and considered it to be an instance of heterotopia of the gastric mucosa.

Thus we have found in the literature, 4 cases of spindle cell sarcomata, 3 cases of malignant leiomyosarcomata, 1 potentially malignant papillary tumor of a sigmoid diverticulum, and 2 cases of argentaffine carcinoid tumors. We submit the following case as that of a true malignant adenocarcinomatous tumor of Meckel's diverticulum.

R. W., white, American male, aged 67 years, carpenter, entered the University of California Hospital on December 19, 1930. The past history and family history were uneventful. Patient complained of vague indigestion, slight loss of weight (7 pounds in 7 weeks), weakness, vomiting, constipation, and severe intermittent abdominal cramps which had been present for about 10 weeks. The cramps were initiated in the lower left quadrant of the abdomen and traveled across to the right lower quadrant. Coincident with these pains he had distention, unrelieved by enemata. Massage of the abdomen caused the gas to move and gave some relief. Borborygmus was marked. Vomiting was induced for relief and the patient said that the vomitus contained food eaten 48 to 72 hours previously, there was no blood in the vomitus. For the past year he had been troubled by constipation as well as a change in the character of the stool from a soft, formed to a hard lumpy, dehydrated stool, there was no blood in the stool at any time. Castor oil gave relief from the constipation.

Physical examination showed a moderately emaciated man, whose skin was sallow and showed evidence of de-

actual resistance against the abductors. When the muscles have been sufficiently strengthened the full internal rotation of the hip is made and abduction is carried out. The full range of motion of the hip is maintained. The attendant who is supervising the exercises must take care that the extension is consummated in the frontal plane or somewhat behind this plane so that the joint to some extent is overstretched. The resistance to abduction should be gradually increased as the muscles gain strength.

The contraction of the hamstring muscles should be prevented by active and passive extension exercises of the knee. These exercises are best combined with the abduction exercises with the aim ultimately enabling the child fully to maintain the leg in complete extension upon the thigh while consummating abduction of the thigh in the frontal plane as previously described. The contraction of the adductor muscles is of course prevented by these abduction exercises. Intelligent and not too vigorous massage is always to be recommended although the massage should be cautioned against any manipulative procedure upon the joint.

The proper after care of case of congenital dislocation of the hip after manipulative reduction can be summarized rather briefly. First and perhaps most important is the permission of function in the primary position after a short preliminary period of bed rest following the operation. Second the maintenance of the primary position throughout the complete term of plaster

confinement. Third a system which insures the gradual automatic correction from the primary position to parallelism of the femur to the vertical accomplished by a gradual diminution of the height of the raised sole of the shoe. Fourth exercises. Fifth night retention in a plaster shell in order to maintain and retain the position fully to reestablish primary position of the hip.

It is not claimed even by the most enthusiastic proponents of the closed method of treatment of congenital dislocation of the hip that the results of this method are approximately 100 percent successful. So many factors are involved: the pathology of this condition and so much depends upon the cooperation of the parents and of the patient that failure is unavoidable in a certain number of cases but this would apply equally to almost any condition in the realm of surgical practice. Under the most exacting supervision and providing treatment is begun sufficiently early a large majority of patients

will attain approximately anatomic and permanently stable reduction. A certain number of cases even if irreducible can secure an improvement if a prosthesis or dislocation is transferred into an anatomic location. The results of this deliberately executed procedure are sometimes extremely useful and are also excellent from a cosmetic point of view. There is little room for doubt that a more meticulous attitude toward the after care following reduction in case of congenital dislocation of the hip will yield a more satisfactory end result than are currently reported.

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As an adenocarcinoma of Meckel's diverticulum is certainly one of the rarest of pathological curiosities, every effort was made to establish all the necessary requirements. The gross and microscopic pathological examinations clearly establish the diagnosis of adenocarcinoma. In Christie's series of cases, the average site of the diverticulum was found to be 1 meter from the ileocecal junction. Von Schaetz found that usually the diverticula inclined orally. The diverticulum in our case fulfilled both of these requirements. Although it was antemesenteric, it was not diametrically opposite to the mesenteric attachment. The lumen was rotated about 6 degrees from this point, but this was caused by the distortion of the ileum by the annular growth which grew out from the base of the diverticulum and encircled the intestine. This requirement of antemesenteric position, however, need not be met in order to establish the diverticulum as a true Meckel's. Many authorities have reported true Meckel's diverticula which were not placed in the axis opposite the mesentery (2, 17, 18)

SUMMARY

A case of primary localized adenocarcinoma arising in Meckel's diverticulum, in a male 67 years of age, is presented. The growth was removed and a lateral intestinal anastomosis was done. To date the patient is free from any symptoms of intestinal obstruction or extension of the tumor. Previously there have been described and reported only 7 other neoplastic processes which were malignant, all were of the sarcomatous variety. A sedulous search of the literature reveals that this is the first case to be reported of a malignant adenocarcinoma of this type in a true Meckel's diverticulum.

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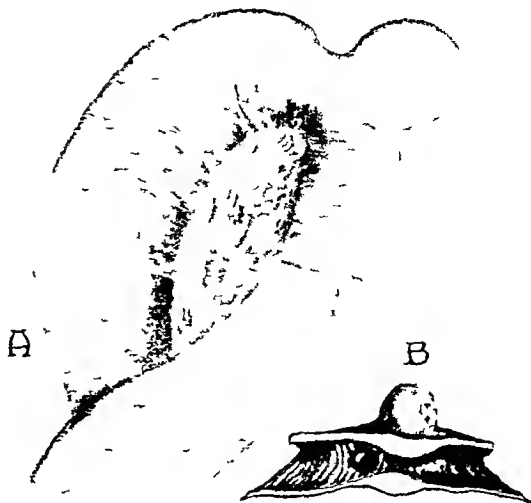


Fig 3 A, Loop of ileum showing diverticulum and hypertrophied intestine proximal to the diverticulum. B, The lumen of the ileum exposed showing intact grape proximal to the constriction, causing a ball-valve obturator type of obstruction.

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f th l m w hyp t phi d N g l d l d
D g n Ad m f th l m g
M k l d r cul m

	Address _____
Patient	
Age	Deep Phlebitis
Sex	Sup Phlebitis
Occupation	Wass
Duration	Urine
Operation	No Injections
Previous Treatment	Average Amt
Location	Cramp
Swelling	Venitis
Pain	Pain
Tired	Slough
Cosmetic	Disability
Ulcer	
Location	Results
Duration	
Healing	
Hæmorrhage	

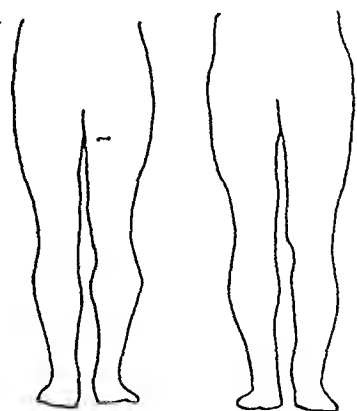


Fig 1 History form

This type of patient generally has large, dilated channels with thick walls, rather than the usual superficial thin walled varicosities. Many of these thick walled channels lie close to the ulcer, feeding its periphery, or, dipping beneath it, supplying its base. These channels, which can be felt only by deep palpation with a practiced hand, must be injected, if healing is to be obtained, even though the injection must be made through thickened, indurated tissue.

Eczema Many of the patients complained of mild varicose eczema. There were 6 patients, however, whose chief complaint was severe eczema with marked itching. One patient (Fig 9) had had this condition for 8 years with no relief for any period of time.

TABLE I—AGE AND SEX INCIDENCE

	Cases
Under 20 years	0
20 to 30	54
30 to 40 years	72
40 to 50 years	88
50 to 60 years	72
60 to 70 years	36
70 to 80 years	3
Total	325
Females	225
Males	100
Total	325

TABLE II—REASON FOR OPERATION

Symptom	Cases	Per cent
Swelling	195	60
Pain	212	65
Tired	254	78
Hæmorrhage	15	4.5
Cosmetic	30	9.2
Job	25	6.5
Recurrence following operation	19	5.9

These 6 cases required an average of four injections apiece of gumme and urethane, and all were completely healed.

Phlebitis We believe that a past history of deep phlebitis has been decidedly over emphasized as a contra-indication for injection. It has been stressed that injection is dangerous in these cases, as, due to the blocking of the deep channels, the superficial veins are very necessary. In our experience, however, we have encountered only one individual with a definite history of deep phlebitis.

TABLE III—VARICOSE ULCERS

Ulcers at time of injection	53 cases, 16.3 per cent
Average duration of ulcer	6.2 years
Average healing time	4.5 months
Ulcers that had never healed	27, the ulcer being present from 1 week to 30 years
Severe varicose eczema	6 cases
Phlebitis, superficial	6 cases, deep 3 cases

TABLE IV—FOLLOW-UP

Average time for healing of ulcer after treatment	6 weeks
Ulcer reopened in	4 cases
Disability—325 patients lost	60 days from work
Follow up examinations were made in	200 cases, 61 per cent
Recurrence of veins found in	15 cases, 4.6 per cent
Ulcers returned in	29 cases of 53 or 55 per cent
Ulcers healed in	47, 88.7 per cent
Ulcers improved in	6

TABLE V—DATA ON INJECTIONS

Number of injections	1753
20 per cent sodium chloride	245
30 per cent sodium chloride	191
40 per cent sodium salicylate	483
Mixture	25
Quinine and urethane	806
Average number of injections	5.4
Sloughs	18
Average time required for treatment—3 weeks	

INJECTION TREATMENT OF VARICOSE VEINS

A REPORT OF THREE HUNDRED TWENTY FIVE CASES

CARNES WEEKS M.D. and R. STERLING MUELLER M.D. and A.

From the First Surgical Division, Bellevue Hospital

SO much has been written on the subject of the injection treatment of varicose veins that it will not be the purpose of this paper to review the literature. This method of treatment is now recognized as being the best one for relieving the patient of varicose veins of the lower extremities. True varicose ulcer and varicose eczema can also be adequately treated through the obliteration of the associated veins. The present report deals with the results obtained in 325 successful cases of varicose veins treated in the Clinic of the First Surgical Division of Bellevue Hospital from November 1, 1918 to September 1, 1930. Included in this paper is the report of a death from pulmonary embolus following ligation of both internal saphenous veins.

Age and sex. Table I shows that 49.4 per cent of the patients were in the age period between 30 to 50 years. No patients under 20 years of age were treated. The oldest patient treated was 77 years of age.

Duration. The average duration of the varicose veins in these 325 cases was 4 years. The longest period of time a patient was afflicted was 40 years.

Sex. Of these cases 25 were females and 100 were males—a ratio of over 2:1.

Reasons for treatment. (Table II). Of the 325 patients 60 per cent complained of various degrees of aching, 65 per cent of pain and 78 per cent of a red feeling in the legs. Four and five-tenths per cent were treated because of recurrent hæmorrhage from superficial varices. Thirty patients mostly women were treated for cosmetic reasons. 65 per cent were young men seeking employment in the police force and post office departments. They had previously been rejected because of varicose veins and 59 per cent were treated because of recurrence following phlebectomy—the interval varying from 1 to 30 years.

Time of treatment. Of the cases had had deep phlebitis 5 and 21 years ago respectively and were successfully treated both showing a marked decrease in the swelling of the afflicted leg. Six cases had had superficial phlebitis—the shortest interval between the phlebitis and the injection being 1 year.

Varicose ulcers. (Table II). Fifty-three or 16.3 per cent of the cases had open ulcers at the time

of the injection. The average length of time these ulcers had existed before treatment was 6.2 years, the longest period 30 years and the shortest 1 week.

One of the characteristics of varicose ulcers is the tendency to reopen after healing. In a study to determine the longest period of time these ulcers remained healed before resort to treatment, it was found that the average period of temporary healing by means of the various treatments supportive bandages and surgical procedures was 4.5 months. Twenty-five or about 50 per cent of the ulcers had never healed for any period of time. Forty-seven that is 88.7 per cent healed with injection, the average healing time being 6 weeks. All of the 6 remaining cases showed some improvement.

Sixty per cent of these cases returned to the follow-up clinic for observation. The longest period of observation to date is 27 months, the average 12 months. Four ulcers reopened, all of which had been treated with salt solution—a solution which we have since discarded as unsatisfactory. These ulcers were subsequently healed through the use of a quinine and urethane solution.

Let us mention here that a dry sterile dressing with a compress bandage is the only supplementary form of treatment used for these ulcers. There were 4 cases in which Unna's paste bandages were required.

An obvious contention would be that many ulcers would heal with compress bandages alone. The majority of our patients who ever had been coming to the clinic for many years and going through all local treatment combined with compress bandages and the ulcers had healed for only short periods of time if at all.

There is no question but that certain types of chronic leg ulcers are not amenable to this form of treatment. We have had to refuse to treat a small percentage of cases of tertiary ulceration because of the lack of palpable veins which could be injected. Some patients however with characteristic bony oedema and no discernible veins expect to bed with the legs elevated. Within a week the oedema had subsided and the ulcer at last it could be injected. We have had 3 such cases and have been successful in securing healing of the ulcer.

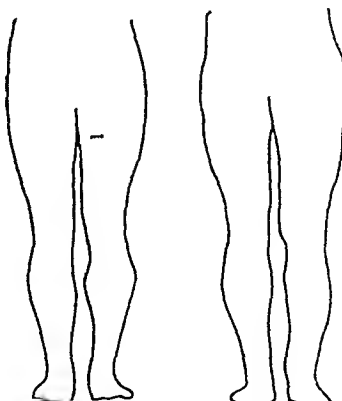
Address _____		
Patient	Deep Phlebitis	
Age	Sup Phlebitis	
Sex	Wess	
Occupation	Urine	
Duration	No Injections	
Operation	Average Amt	
Previous Treatment	Cramp	
Location	Venitis	
Swelling	Pain	
Pain	Slough	
Tired	Disability	
Cosmetic		
Ulcer	Results	
Location		
Duration		
Healing		
Hæmorrhage		

Fig 1 History form

This type of patient generally has large, dilated channels with thick walls, rather than the usual superficial thin walled varicosities. Many of these thick walled channels lie close to the ulcer, feeding its periphery, or, dipping beneath it, supplying its base. These channels which can be felt only by deep palpation with a practiced hand, must be injected, if healing is to be obtained, even though the injection must be made through thickened, indurated tissue.

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Mixture	25
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Average number of injections	5.4
Sloughs	18
Average time required for treatment—3 weeks	



Fig 2. Ulcer of the left leg. D. t. y. H. h. d. Th. h. d. b. led. Th. l. g. t. t. F. l. w. p. f. 6 m. th. UI. l. h. a. l. e. d. d. n. c. o. s.

whose veins we were unwilling to inject. In this case we constructed the superficial veins with a tight compression bandage and instructed the patient to walk a distance of several blocks. This walking resulted in extreme pain and cyanosis of the lower leg which voided these superficial veins to be essential. Other patients with similar history were treated identically and returned from the walk with a sense of added support in the leg. These were injected with good results and a complete disappearance of swelling and pain.

On the other hand numerous cases of recent superficial phlebitis associated with varicose veins have been refused treatment by us and instructed to return in 1 year—the shortest interval we feel to be compatible with safety. The danger of injection after too short an interval has been ade-



Fig 4. Multiple ulcers of both legs. D. t. y. H. h. d. b. led. Th. l. g. t. t. F. l. w. p. f. 6 m. th. UI. l. h. a. l. e. d. d. n. c. o. s.



Fig 3. Ulcer of the left leg. D. t. y. H. h. d. Th. h. d. b. led. Th. l. g. t. t. F. l. w. p. f. 6 m. th. UI. l. h. a. l. e. d. d. n. c. o. s.

quately substantiated by the fact that most of the few reported deaths following this treatment have occurred in such infected cases.

It might be well to mention here the death of a patient with a definite history of acute phlebitis 3 months before which had confined her to bed for 1 month. She was referred to us for injection of her external varicose veins. Treatment was refused by us because of the danger of pulmonary embolus. She was admitted to the hospital however by another physician for ligation of both internal saphenous veins. After an eventful 11 day postoperative course she was allowed up and died within 2 hours quite suddenly. Autopsy showed a embolus of the left branch of the pulmonary artery with a thrombus formation about one inch in length above the ligation of the left



Fig 5. Patient with ulcer of the left leg. D. t. y. H. h. d. b. led. Th. l. g. t. t. F. l. w. p. f. 6 m. th. UI. l. h. a. l. e. d. d. n. c. o. s.



Fig 6 Ulcer of the left leg Duration 6 years Never healed Injections with quinine and urethane and 4 months' follow-up



Fig 7 Ulcer of the left medial malleolus Duration 2 weeks Injections with 40 per cent sodium salicylate and quinine and urethane Fourteen months' follow-up

internal saphenous vein We feel that we cannot overemphasize the importance of the danger in injections and still more in saphenous ligations following a recent acute phlebitis, as the deaths from pulmonary embolus that have been reported following varicose vein injection have occurred usually in such cases

If it was dangerous to inject such a case, it was many times more dangerous to ligate the saphenous veins

Injections A total of 1,753 injections were made in 325 patients—an average of 5.4 injections for each case One patient with very extensive varicosities required 43 injections, though many cases required but a single treatment

Twenty per cent sodium chloride was given 245 times and 30 per cent sodium chloride 191 times This was the first solution used by us Its use was abandoned, however, when we found that the veins became recanalized after a short interval In many cases this solution, instead of forming a thrombus which entirely filled the lumen of the vessel, caused marked thickening of the vessel wall without obliteration, thus rendering further injections with other solutions more difficult We did not find this to be the case with other solutions

Forty per cent sodium salicylate was used 483 times We find this an excellent sclerosing agent used in 5 cubic centimeter doses, with both ra-

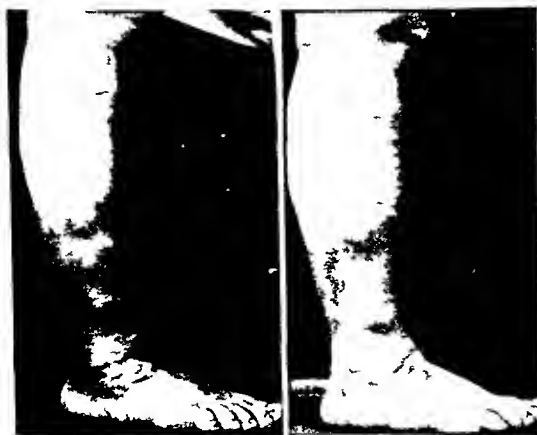


Fig 8 Small ulcer of right external malleolus Duration 8 months Extremely painful Injections with 40 per cent sodium salicylate Photograph 4 months later Follow up of 1 year



Fig 9 Varicose eczema of the left leg Duration 8 years No healing at any time and intense itching One large vein seen Four injections of 40 per cent sodium salicylate Photograph 3 months later with relief of condition Follow up 1 year



Fig 1



Fig 2



Fig 3

Fig 1 R cu t l g th sc f th
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th l h t g ph m th l t F l w p 7
mo th

Fig 2 Ph t graph m th ft 5 j t f q
d tha F l w p y
Fig 3 Th m ths ft j t f 4 p t
sod m l cyl t

pidity and sueness of action. Its one great advantage is the great severity of the cramp which accompanies its use—more severe than with the use of any other solution. A mild systemic reaction accompanied by dizziness and a general feeling of malaise is not uncommon. One woman developed a rather marked skin eruption with swelling of face, lips, tongue and hands which subsided after 3 days. A mixture of 5 per cent dextrose and 0 per cent sodium chloride was used twenty five times but the result obtained with it is similar to that obtained with hypertonie sodium chloride. Quinine and urethane, cubic centimeter doses has been used 806 times and has been very definitely the treatment of choice. Some peo-

ple are sensitive to quinine however and previous to injection such a history may be elicited. An immediate coryza with coughing and sneezing is occasionally seen but usually lasts but a short time. Sloughs. On the most unpleasant complications of the injection treatment is the occasional occurrence of sloughs. For the most part however their occurrence is due to an error in technique either a perivascular injection is made or leakage occurs after the withdrawal of the needle. A note therefore in learning to give the treatment is quite likely to have this occur. Obviously a teaching clinic where internes are being trained in this procedure the percentage of sloughs is inevitably comparatively high. This accounts for the large number of sloughs in our series and in the past year at least two small sloughs have been caused by ourselves.



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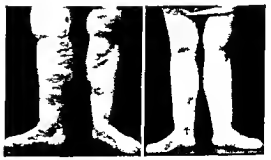


Fig 4 1 m h ft ject f so l m sal y
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Fig 15 Four months after 7 injections of 40 per cent sodium salicylate and 3 of quinine and urethane

In all we had 18 sloughs. Most of these were less than 1 centimeter in size, and caused very little trouble or pain to the patient. No large sloughs requiring surgical excisions occurred. The greatest number developed after the use of salt solution, while only 3 occurred after injections of the quinine and urethane.

The average healing time for the sloughs in our series was 11 weeks. The ordinary slough, after the surrounding inflammation has subsided, is non-painful and is best treated with bland ointments. Later, when the slough has separated and granulations are appearing, a stimulating ointment is required.

Periarteritis The periarteritis, which is so apt to occur following the injection of large veins, we believe insures an excellent obliteration. The area involved is red, tender, and sometimes swollen. This condition usually subsides within 3 to 4 days and in very few cases will it be so severe as to require rest and wet dressings. We have found that a stronger reaction results from salicylate than any other solution.

Disability We have attempted to discover as accurately as possible the amount of time in days lost from work by the patients, due to pain and discomfort, and we have found that in the 325 individuals the total number of days lost from work was 60. The shortest time lost was 1 day, and the longest 2 weeks. The latter patient was suffering from a slough which occurred in the early days of our experience. These 60 days are all in marked contrast to the 6,825 days which would necessarily be lost by an equal number of patients

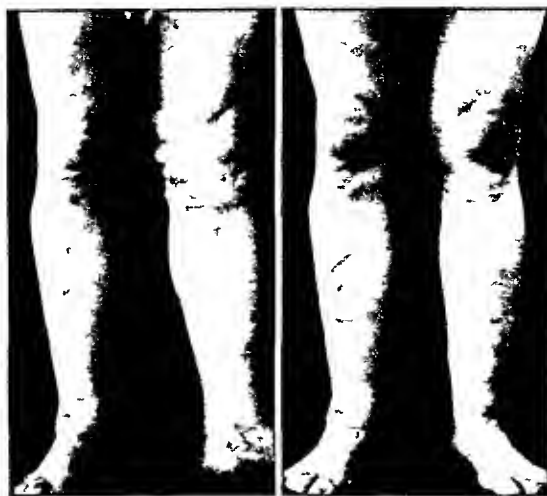


Fig 16 Three months after 3 injections of quinine and urethane and 3 of 40 per cent sodium salicylate. Note the appearance of enlarged veins of the right leg in the later photograph.

undergoing phlebectomy—allowing only for the 21 days in bed after operation, let alone convalescence.

There has been in our series no mortality, no case of infection, and no other unpleasant complication beside the recorded sloughs.

Time for treatment The average time required for obliteration of the offending veins was 3 weeks.

TECHNIQUE OF INJECTION

When the patient is first admitted, a history form, as shown in Figure 1 is filled out, and the



Fig 17 Five and one half months after 6 injections of quinine and urethane

offending veins and ulcer if present are marked on the diagram. A physical examination is done only in those cases in which a cardiac or nephritic condition is suspected. Wassermann tests are made on all ulcer cases and photographs are taken both before injection and after a follow up of 6 months.

We prefer to treat varicose veins associated with pregnancy with supportive bandages rather than to run the risk of abortion—a very probable sequence of repeated injections of quinine and urethane or salicylate. We also find it inadvisable to inject veins during the first few days of menstruation as it usually increases dysmenorrhea and its accompanying symptoms.

We believe that in a large clinic the simpler the technique the better the results.

A 5 cubic centimeter hypodermic syringe is used. It is important that the needle be sharp, short beveled and of small bore.

As the current of blood in the majority of cases is from above downward we find that the most satisfactory point for the first injection is in one of the proximal groups of veins.

Patients who have small or medium sized veins are injected while standing then placed in a horizontal position for 5 minutes. Those patients whose veins are large are usually injected while prone to obtain the collapse of the veins so that the fluid may exert its maximum effect on the endothelium of the vein without too much dilution. In each case the needle is left in situ for 3 minutes to enable the injected fluid to work on the intima of the lumen. After this with draught to prevent leakage firm pressure is exerted at the site of injection. Whenever there is any suspicion of leakage outside of the vein

however 5 to 10 cubic centimeters of normal saline solution is injected about the site of the original injection. If pressure is applied too early the sclerosing agent is diffused too rapidly.

Follow up. Of 325 patients treated 200 approximately 61 per cent returned for follow up examination. The period of time elapsing ranges from 1 to 7 months. Fifteen of these patients had developed a recanalization of the injected veins. These were all cases as previously stated.

which had been injected with 20 per cent or 3 per cent salt solution. We have seen no recurrence following salicylate or quinine and urethane injections. Eight cases needed further treatment simply because small veins had not been treated and had dilated in the interim.

CONCLUSIONS

The injection treatment is the safest and surest method of ridding the patient of varicose veins. No mortality should occur if cases suffering from recent superficial phlebitis are excluded.

2. This is an effective method of treating varicose ulcer and varicose eczema. In our series 88 per cent of such cases were healed and remained so according to our follow up observations.

3. The technique should be simple and simple injections at each treatment should be given.

4. Quinine and urethane is our solution of choice because of sureness of results and absence of cramp. Forty per cent salicylate is also a splendid sclerosing agent but severe cramp accompanies its use. We find 20 to 30 per cent salt added to glucose and saline mixtures satisfactory solutions for injections as they are more apt to cause sloughs and too they account for the entire number of recurrences noted at follow up.

THE NECESSITY FOR BRONCHOSCOPIC EXAMINATION IN DISTINGUISHING PRIMARY CARCINOMA OF THE BRONCHUS FROM SUPPURATIVE DISEASE OF THE LUNGS

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OBSTRUCTION of the bronchus is almost always followed by suppurative disease of the lung. When the obstruction is removed, the rapidity of resolution of an inflammatory pulmonary process is remarkable. This is strikingly illustrated in case of foreign body in the air passages where suppurative processes begin soon after aspiration has occurred and usually resolve with great rapidity after the foreign body has been removed even though it has been present in the lung for months or years. When one remembers the fact that primary malignant disease in the lung usually begins in a bronchus and produces bronchial obstruction, it is not strange that the symptoms of primary bronchial carcinoma should resemble those of pulmonary abscess, bronchiectasis, or empyema.

In a recent review of 71 cases of bronchial carcinoma, proved by tissue removed from the bronchus at bronchoscopic examination, I was greatly impressed with the fact that in many cases the clinical and laboratory evidence suggested that the lesion was inflammatory only.

It is, of course, quite impossible to distinguish carcinoma of the bronchus from an inflammatory lesion in the lung or pleura by the history or by general examination, roentgenoscopic examination in 23 cases showed evidence of abscess or bronchiectasis only. Fever was present in more than half of the cases (38) and the leucocytes numbered more than 10,000 in 31 cases. The highest leucocyte count was 22,500.

There is no better method of making a positive diagnosis of primary bronchial carcinoma than by removing a specimen of tissue through a bronchoscope from a bronchial lesion. Even in the presence of metastasis to the cervical or axillary lymph nodes, bronchoscopic removal of tissue from a bronchus is preferable to the surgical removal of a lymph node for examination.

In many instances, an inflammatory bronchial lesion may have the gross appearance of carcinoma, the reverse is true also. Therefore, one should remove tissue for examination from every bronchial lesion if malignant disease is suspected and I may add that carcinoma of the bronchus

should be suspected whenever the bronchial wall is infiltrated.

It has become almost a routine procedure in The Mayo Clinic to subject to a bronchoscopic examination every patient with cough and expectoration or pulmonary hemorrhage, if the usual methods of examination have failed to reveal the presence of tuberculous disease in the lungs. Failure to adhere to this procedure will result in delay in diagnosis and misdirected surgical treatment.

For the purpose of illustrating some of the difficulties involved in the diagnosis of carcinoma of the bronchus, I am presenting the following cases.

CASE 1 A man aged 30 years, came to the clinic July 25, 1928. He had been well until April, 1928, when an acute cold developed with cough, chills, fever, loss of weight and strength, and the expectoration of sputum streaked with blood. About 3 weeks before admission to the clinic, his condition became worse and there was considerable dyspnea and pain in the left side of the thorax. July 6 a portion of a rib was resected elsewhere. Needles were inserted into the lung but fluid was not obtained.

Examination revealed diffuse infiltration in the lower lobe of the left lung with evidence of thickening of the pleura (Fig. 1). The temperature ranged from 101 to 102 degrees F and the leucocytes numbered 17,000 to 18,000. The left side of the thorax was aspirated at four points around the scar of the previous operation, with negative results. August 7, a bronchoscopic examination was made and an infiltrating ulcerating lesion was found in the bronchus to the lower lobe of the left lung. A specimen of tissue was removed for microscopic examination and proved to be a squamous cell epithelioma, graded 4. The patient died at his home in December, 1928. Post-mortem examination revealed malignant disease throughout the left lung without any evidence of metastasis.

CASE 2 A man, aged 57 years, came for examination July 11, 1930. Since the age of 10 years, he had had a cough, expectorating a moderate amount of sputum. At the age of 17 this was associated with considerable pain in the thorax particularly on the left side. At the age of 30 years, the pain in the thorax disappeared but the cough persisted. Four months before admission to the clinic, he had contracted a severe cold, which was accompanied by fever and a daily chill. He was observed in a sanatorium for about 3 months and after pus had been aspirated from the right pleural cavity a diagnosis was made of empyema on the right side.

The patient was thin and pale and had lost 20 pounds in weight. Examination of the thorax revealed dullness, absent breath sounds, and absent vocal fremitus over the



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Fig 4 Extensive pleural thickening on the right side may be noted. This is apparently associated with effusion.



Fig 5 Infiltration in the upper lobe of the right lung, apparently an abscess, with bronchiectasis at the base of the left lung.

in 1924 from which he had recovered completely. A second attack began March 8, 1927, and he was acutely ill for 9 weeks. Following this there was continuous fever, pain in the right side of the thorax, cough, and expectoration. A diagnosis had been made elsewhere of pulmonary abscess, and bronchoscopic drainage was attempted without benefit. Lipiodol was injected into the lung and the patient was informed that a cavity was seen.

Examination disclosed infiltration in the base of the right lung with evidence of a pulmonary abscess and probably empyema. There was moderate secondary anemia, leucocytes numbered 21,000. Roentgenograms of the thorax disclosed an abscess in the lower lobe of the right lung with areas of bronchiectasis in the lower lobes of both lungs and thickening of the pleura on the left side (Fig 3). Bronchoscopic examination disclosed an ulcerating lesion occluding the lumen of the bronchus to the lower lobe of the right lung and tissue removed for examination was reported to be squamous cell epithelioma, graded 3. Roentgen therapy was carried out at the patient's home in conjunction with radium introduced through a bronchoscope directly into the growth. Marked temporary improvement followed this treatment with a gain of 40 pounds in weight. The patient is still living, his health apparently is failing.

Case 4. A man aged 47 years was admitted to the clinic May 15, 1929. He had been well until February 1, 1929, when his temperature rose to 103.5 degrees F. After the fever had persisted for 2 weeks without other symptoms it was decided that numerous abscessed teeth were responsible for it and they were extracted. For a week after this the patient was free from fever, it then recurred and when he came to the clinic the temperature was 102 degrees F. He had lost 60 pounds in weight and his strength was correspondingly reduced.

Examination disclosed a moderate amount of dyspnea but no other pulmonary symptoms. Marked dullness to flatness of the percussion note was observed on the right side of the thorax below the second rib anteriorly with a diminution in breath sounds and absent vocal fremitus over the same area. A small lymph node was found in the right axilla. There was moderate secondary anemia, the leucocytes numbered 11,500. Roentgenograms of the thorax revealed thickening of the pleura with fluid on the right side (Fig 4). Because of the insidious onset of the illness, the diagnosis of malignant disease in the lung was considered, but it was thought advisable to perform diagnostic thoracentesis.

May 18, 1929 the right pleural cavity was aspirated and 1,800 cubic centimeters of thick creamy greenish pus was withdrawn, a catheter was inserted for further irrigation of the cavity. Culture of the pus showed the presence of diplococcus pneumoniae (type II). An inflammatory type of lymph node was removed from the right axillary region. After a month of treatment the patient was permitted to return home until August 20, 1929. Shortly after leaving the clinic he began to cough and to expectorate blood stained sputum, on one occasion, he spat up about 15 cubic centimeters of blood. When he returned for re-examination it was decided to perform an open operation on the empyema cavity and this was done August 24 with the resection of two ribs. Following this the cavity became progressively smaller but in spite of satisfactory improvement in the local lesion the patient's general condition became worse. December 11, bronchoscopic examination revealed an extensive epithelioma completely occluding the lumen of the right main bronchus. Tissue was removed for microscopic examination which revealed squamous cell epithelioma, graded 4. Deep roentgen ray treatment was instituted but the patient died.

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THE PELVIC DIAPHRAGM IN THE FEMALE—ITS FORM FUNCTION AND A METHOD OF REPAIR FOR LACERATION¹

HOWARD HILL M D F A C S D W I G H T T A N D E L M D K S A S C I T M S S O R T

THE female pelvic diaphragm is of such great importance in the function of childbearing and its attendant after results that for the past century it has merited the attention of the anatomist and the surgeon. Numerous descriptions have been written concerning the anatomy of this region but since artefacts due to partition have not been recognized many of them have been incorrect. In order to appreciate the significance of the pelvic diaphragm a review of its development is not amiss.

In the process of evolution Nature has made a series of physiological experiments and the results are combined in the present day types which have survived. In the log fish *Scyllium canaliculatum* the pelvic girdle is a transverse bar of cartilage placed anterior to the cloaca and it is connected to the vertebral column by a portion of the lateral trunk musculature which extends forward from the tail into the body. Where this muscle passes over the pelvic bar a portion of the strongest fibers are attached to this cartilage. This band of muscle fibers of the ventral tail musculature runs forward behind for the pelvic bar and is called the caudopelvic muscle. Behind the cloaca the caudopelvic strands border upon its fellow of the opposite side and as the pelvic bars approached these strands diverge somewhat to surround the cloacal opening. This forms a pelvic diaphragm scarcely exists.

Evolution of the pelvic bar resulted from the amphibian. The ileum in the salamander articulated to the rib of the single sacral vertebra thereby making possible a different form of

upon the spine. In the menibanchus there is no sphincter cloacae however since the animal is entirely aquatic the absence of this muscle is easily understood. The salamander is terrestrial and in this animal the sphincter cloacae is abundant. The lack of a sphincter muscle is explained by the presence of the well developed caudopelvic muscles. The pelvic muscles arise in the median line of the tail and they insert on the pelvic plate in such a manner that their inner borders are in apposition. When they contract synchronously the pelvic plate is fixed by the rectum and the cloaca is laterally compressed thereby closing the genital opening.

In reptiles the sacral vertebrae appear which are bound together by fibrous tissue. The pelvic complex is completed inferiorly by the articulation of the ischial and pubic bones which form a median symphysis. The caudopelvic muscles are well developed in the lizards namely iguana. Instead of a single muscle as in some of the lower vertebrates the caudopelvic muscles are present. The pelvic muscles arise in the tail from a common tendon and as they extend forward they rapidly diminish in size giving rise to a tendon which is inserted on the ventrolateral aspect of the pubis. These muscles travel forward to the cloaca is situated between the medial borders.

A comparison of the anatomical conditions in the study of the mammal indicates that the human is a transitional form between the crocodile and the mammal. The crocodile presents modified structures the human. The caudopelvic muscles are poorly

developed and their function in part has disappeared since the pelvis in the crocodile is completely ankylosed to the spine. These muscles exist only for a pressure effect on the pelvic cavity and cloaca, as they are inserted very close to the midline of the pelvis. Hence a review of the increasing complexity in the mode of life, from fishes to reptiles, indicates that the muscles which close the pelvic outlet are maintained for the most part wholly for a pressure effect.

In the great majority of terrestrial mammals, three pairs of muscles, connecting the pelvis with the tail, form an efficient closure of the pelvis. These muscles, which in the lower vertebrates were named the caudopelvic strand, are now designated as the pubo-ilio and ischiococcygeus muscles. In pronograde primates these pelvic floor muscles exist as well developed muscular sheets placed in two layers on each side of the pelvic cavity. The inner layer consists of the iliococcygeus and pubococcygeus, which in man form the levator ani muscle. The outer layer, or ischiococcygeus, represents the coccygeus muscle of human anatomy.

The iliococcygeus and pubococcygeus form a continuous sheet, the posterior margin of the one being contiguous with the anterior margin of the other. The pelvic line of attachment extends along the internal aspect of the pubic symphysis in the whole of its extent, and along the iliopectineal line as far dorsally as the spine of the ischium. The fibers converge from this wide origin and they pass backward and upward to be inserted into the ventral midline of the root of the tail. The iliococcygeus at its insertion ends in a fascial strand placed lateral to the pubococcygeus muscle. These two muscular sheets together, one on each side, form a funnel shaped closure of the pelvis from the abdominal cavity to the perineal region. At their origin and insertion the iliococcygeus and pubococcygeus muscles are attached to the midline and are in apposition with each other. Throughout their course they are separated only by the rectum and urogenital passages, which leave the pelvic cavity by passing between them. Toward the outer side of the previously mentioned muscular layer is the ischiococcygeus muscle, the thickness of which varies in different species. It arises from the ischial spine and is inserted into the lateral aspect of the tail root.

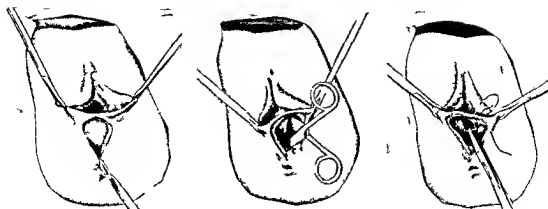
In the pronograde mammals, the pelvic floor muscles have been described as arising from the pelvis and being inserted onto the coccygeal vertebrae. On the other hand, in fishes, amphibians, and reptiles the caudopelvic muscles

originate in the tail and are inserted in the pelvis. This difference is due to the fact that the proximal portion of the tail, in non-mammalian vertebrates, is rigid in the dorsoventral plane, being only freely movable from side to side, while the pelvis, excepting in the crocodilia, moves to and fro upon the sacrum. However, the tail when present in pronograde mammals is movable in all directions and the pelvis is fixed by bony ankylosis to the spine. Hence, in mammals these muscles should be described as arising from the pelvis, since that is the more stationary point.

There is a point of significance in the method of insertion of these muscles in the mammalian and non-mammalian vertebrates. In fishes, tailed amphibians, and reptiles, the caudopelvic muscles are attached to the tail at a considerable distance from the pelvis, and they are nearly in the same straight line as the recti muscles. Thus, the caudopelvic muscles appose the pull of the recti, in other words, the two groups of muscles acting synchronously, fix the movable pelvis. However, in pronograde mammals, such as primates, where the pelvis is permanently fixed, the attachment of the caudopelvic muscles has moved forward to the tail root, so that instead of being in the same straight line as the recti muscles, they are at right angles to them.

By some writers the pelvic floor muscles are considered to function as tail-moving muscles. However, in the ungulates which have a freely movable tail, the pubococcygeus and iliococcygeus are lacking while in the carnivora, in which the tail is movable, these muscles are present. Therefore, efficient movement of the tail does not depend on the presence of pubococcygeus and iliococcygeus muscles, since this movement occurs in their absence. Furthermore, a well developed ischiococcygeus muscle is present in carnivora and ungulates, but it has no effect on the distal and most movable part of the tail.

Since, in the tailed mammals, the pelvic floor muscles are said to be tail-moving in function it is assumed that with the degeneration of the tail, these muscles have also deteriorated. In man the tail has degenerated, therefore, it is assumed that the homologues of these muscles have also shared in the degenerative process. The theory is good but the assumption is fallacious. In man the representatives of the true tail-moving muscles, namely the sacrococcygei, have degenerated with the coincident loss of the tail, while the pelvic floor muscles, although considerably changed are markedly developed. By a study of the evolution of these pelvic floor muscles in fishes, amphibians, and reptiles, it is seen that their function is not to



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Fig 3

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Fig 3 L ft t na l m p l d f r w d d tw d
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Fig 3 N edl p d th gh th l ft l t m ad
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move the tail but to fix the pelvis and to function in the production and maintenance of normal visceral pressure. In mammals these muscles have the same act on and in man even though the tail has been generated they function perfectly. However in tailed mammals the external muscles maintain increased visceral pressure one of two ways either by drawing the root of the tail against the perineum or when the tail is held in extension by the dorsal sac coccygei they simultaneously in case the contraction.

Until the pelvis in the process of evolution becomes firmly fixed the muscular arrangement that occurs in fishes reptiles and amphibians appears logical. However the real reason for such an adjustment appears when the pelvic bones mesopelvic and epipelvic are situated in man with the assumption of the upright position. At this time the muscles cross the pelvic outlet in the short route possible occlude the pelvic outlet and play a part in the maintenance of external pressure. Thus though the external pelvic muscles are found that the pelvic floor muscles are not degenerated tail muscles and that these muscles assist in the production and maintenance of a frequently occurring increased external pressure.

The pelvic floor is a thick compact mass traversed by clefts of variable size which are normally in contact but which open for the passage of material through their hani. The pelvic floor includes all the structures which close the outlet of the pelvis. In the human sub-

ject the assumption of the erect posture necessitates certain modifications and here the function of the pelvic floor are different from those found in animals in which the lower part of the body is horizontal. In all mammals the closure of the clefts in the pelvic floor is obtained by the action of muscular fibers and the mesopelvic pelvic floor is not the simplest form composed of muscle connective tissue and skin. Hence the layer is a gely sphincteric in action and therefore is not very efficient as a support.

In these animals who have assumed the upright position a further modification of the abdominal pelvic floor has occurred. In addition to the layer of sphincteric muscle on the group of muscles in action and attached to the walls of the pelvic cavity is developed which forms a wide muscular diaphragm. In the human subject this diaphragm is the levatores ani and coccygei muscles. Thus the highly specialized pelvic floor consists of a compact mass in which two distinct strata of muscles may be differentiated. The upper layer supports and functions in a compact plate pelvic diaphragm the inferior rect for the purpose of control of the pharynx which surround the penile of the canal which perforate the floor in order to reach the exterior. These groups of muscles perform different functions and morphology. The pharyngeal group is derived from the primitive pharyngeal layer while the muscles of the pelvic diaphragm the levatores ani and coccygei muscles are traced to the pelvic moving muscle of the lower animal.

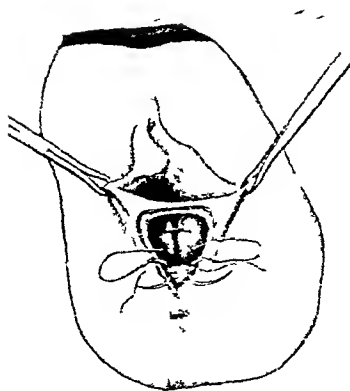


Fig 4

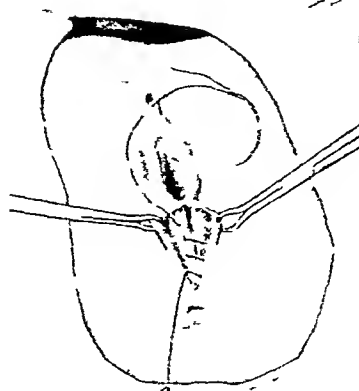


Fig 5

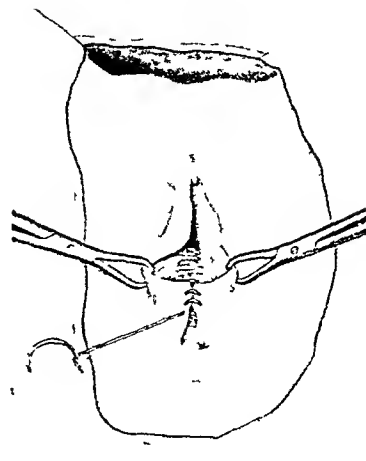


Fig 6

Fig 4. First suture in the levator muscle is tied. The second suture now passed through the lower portion of the levator and a portion of the sphincter ani muscle included before the suture is tied.

Fig 5. Closure of the trigone. The suture may begin at the lower portion of the trigone as shown, or the first

stitch may be inserted at the upper portion just under the skin at the junction of vaginal mucous membrane and vulvar skin. An interrupted or continuous suture may be used.

Fig 6. Approximation of the skin by continuous over-and-over or mattress suture.

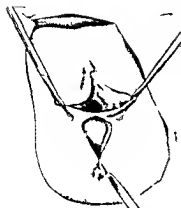
The pelvic floor in the adult human female consists of two segments or planes. The superior plane, or pelvic diaphragm, is composed of the paired levator ani muscle with its two investing fasciæ. The upper one is the rectovesical fascia, or fascia diaphragmatis pelvis superior, and the lower layer is the anal fascia or fascia diaphragmatis pelvis inferior. The inferior plane is limited to the urethral triangle and is known as the urogenital diaphragm or trigone, which is composed of the deep transverse perineal muscle and two layers of fascia.

The superior and inferior layers of the triangular ligament or urogenital diaphragm are homologous with the obturator membrane, and they are a part of the ligamentous wall of the pelvis. The ligament, triangular in shape, extends completely across the pelvic arch from the anterior margins of the ischial tuberosities to near the symphysis pubis, at which point is found the dorsal vein of the clitoris. The two layers of the triangular ligament are fused at their base and apex. The muscular compartment between these sheets is composed of the sphincter urethræ in the anterior portion while the posterior part consists of the deep transverse perineal muscle which is inserted into the perineal center, and acts, to some extent, as a tensor fasciæ. These three layers form a strong musculo-fibrous plane attached to the bones of the pelvic outlet and placed beneath and parallel to the puborectalis muscle, for which it serves

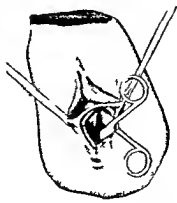
as a support. The triangular ligament is perforated by the urethra and vagina.

The levator ani is a paired muscle which is divided for description into an anterior portion, the puborectalis, and a posterior portion, the iliococcygeus. The puborectalis arises from the posterior face of the body of the pubic bone and is separated from its fellow of the opposite side by an interval of 2 centimeters. The muscle is a broad, flat bundle about 2 centimeters in width and it passes downward and backward along the side of the vagina, where it divides into two portions. The innermost division, the levator vaginæ, continues backward and downward until it reaches the posterior margin of the urogenital trigone. At this point, the muscle turns sharply downward and inward and forms a loop with similar fibers of the opposite side, in the space between the lower end of the vagina and the terminal portion of the anal canal. As the levator vaginæ turns in toward the median line, it gives off from its outer side, a thick bundle of fibers which run into the angle of the sphincter ani muscle. Some of these fibers are continuous in the anterior extremity of the sphincter ani as far as the median line. The outer division of the puborectalis muscle continues backward, passing wholly above the sphincter ani, and joins similar fibers from the opposite side behind anal canal at perineal flexure level.

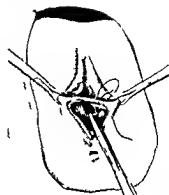
The iliococcygeus muscle arises in a continuous line from the arcus tendineus musculus levator



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p b tw th g l li d th f sc g th
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move the tail but to fix the pelvis and to function in the production and maintenance of normal visceral pressure. In mammals these muscles have the same action, and in man even though the tail has degenerated they function perfectly. However, in tailed mammals these muscles maintain increased visceral pressure in one of two ways: either by drawing the root of the tail against the perineum or when the tail is held in extension by the dorsal sacrococcyge they simultaneously increase their contraction.

Until the pelvis in the process of evolution becomes firmly fixed, the muscular arrangement as it occurs in fishes, reptiles, and amphibians appears logical. However, the real reason for such an ally stem it appears when the pelvis becomes fixed and especially is this true in man with the assumption of the upright position. At this time the muscles closing the pelvic outlet, the shortest route possible, occlude the pelvic outlet and play a part in the maintenance of visceral pressure. Thus throughout the evolution of mammals we find that the pelvic floor muscles are not degenerated tail moving muscles and that these muscles exist for the production and maintenance of a frequently recurring increased visceral pressure.

The pelvic floor is a thick compact mass traversed by clefts oraults the all of which are normally in contact but which penetrate the passage of material through their channel. The pelvic floor includes all the soft structures which close the outlet of the pelvis. In the human sub-

ject the assumption of the erect posture necessitates certain modifications and here the functions of the pelvic floor are different from those found in mammals in which the long axis of the body is horizontal. In all mammals the closure of the clefts in the pelvic floor is obtained by the action of muscular fibers and the mass forming the pelvic floor is in its simplest form composed of muscle connecting tissue and skin. Hence the layer is largely sphincteric in action and therefore is not very efficient as a support.

In these animals who have assumed the upright position a further modification of the above simple pelvic floor has occurred. In addition to the layer of sphincteric muscles another group appears in action and attached to the walls of the pelvic cavity is developed which forms a wide muscular diaphragm. In the human subject this diaphragm closes the levatores ani and coccygei muscles. Thus the highly specialized pelvic floor consists of a compact mass in which two distinct strata of muscles may be differentiated. The upper layer supports a function forms a complete pelvic diaphragm the inferior executed for the purpose of controlling the sphincters which surround the penings of the canals which perforate the floor in order to reach the exterior. This group of muscles are different in function from the morphogeny. The sphincter group is derived from the primitive sphincter clacae while the muscles of the pelvic diaphragm the levatores ani and coccygei muscles are derived to the pelvic moving muscles of the lower animals.

and the passenger In the normal course of labor perineal lacerations occur in about 45 per cent of patients, the majority being primiparæ Other causes for laceration are rapid expulsion of the child, so that tearing of the perineum instead of stretching results Again, a faulty mechanism of labor may occur in which the largest circumference of the head passes the perineal ring thus causing a rupture The use of forceps may be a cause for perineal injury Rapidity of delivery is probably the most frequent cause for perineal laceration This condition is particularly seen in cases of precipitate delivery where the head rapidly advances through the birth canal and impinges on the perineum with great force This mechanism is noted in cases of contracted pelvis, in which strong pains are needed to force the head through the inlet of the pelvis, with the result that the less resistant soft parts are torn Pressure of the head on the perineal body and lack of retraction between pains, causes perineal injury The maternal soft parts become anæmic and tense, and tear easily with further advance of the head

The site and extent of the tear depends on the comparative strength of the structures involved Superficial injury to the vaginal wall is always to be found in the vaginal sulci on one or both sides, and never involves the posterior vaginal column, a point to be considered in repairing these injuries The sulcus tear is due to extreme weakness of the vaginal wall on either side of the column Opinions vary in regard to injuries of the levator ani muscle Observation of recent tears and dissection of healed ones show that the levator vaginae muscle is torn in the median line down to the rectal wall and the attachment of the sphincter ani muscle is ruptured to a greater extent on one side, although the fibers inserted into the cornu of the sphincter are torn on both sides It seems reasonable to expect that this would be the case, since these fibers of the levator vaginae muscle are exposed equally with the lateral thick portions of the puborectalis to the strain, resulting from the passage of the child It involves a matter of resistance, and the lateral mass of the puborectalis is stronger than the levator vaginae muscle

The firm attachment between the levators and the outer angle of the sphincter is the explanation for complete tears In such cases, after a laceration of the levator loop, the pressure falls on the sphincter and it gives way The superficial muscles are torn in various ways Most frequently the skin tear occurs slightly to the right or left of the median line and the bulbocavernosus

and transversus perinei muscles are torn in the same direction A constant lesion is found, that of abrupture of the attachment of the anterior extremity of the sphincter from the bulbocavernosus muscle, thereby allowing the sphincter to retract toward the coccyx

As a result of the laceration of the fibers of the levator muscle, which are attached to the sphincter, the anal canal prolapses downward and is drawn backward by the sphincter Such a condition gives rise to the formation of rectocele Injury to the urogenital trigone is very common and depends on the comparative inelasticity of this supporting structure It is torn backward, separating with slight retraction, in two portions, which can be easily found at operation Many cases occur in which the levator muscle fibers as well as the urogenital trigone are torn down to the rectum, while the superficial perineal muscles remain intact As a result of this situation the pelvic diaphragm becomes weakened, and as intra-abdominal pressure is focused on this torn area, relaxation becomes more marked At times there is an internal laceration of the levator muscle fibers while the superficial components of the perineum remain intact The latter are inefficient in supporting the pelvic structures, hence, cystocele and rectocele occur, notwithstanding that the perineum on superficial examination appears normal If one is familiar with the anatomy of the levator muscle, the diagnosis of internal separation is easily made by palpation of the intervening tissues when one finger is inserted into the rectum and one in the vagina

The principles which underlie the numerous operations for injury to the pelvic floor are precisely the same as for those which underlie operations for ventral hernia All surgeons agree that the rational method of operation for ventral hernia is anatomical restoration of the abdominal wall by buried suture If the pelvic diaphragm and urogenital trigone compose the floor of the female pelvis and if injury to these structures gives rise to a relaxed vaginal outlet with prolapse of the pelvic organs, then the proper method of repair would be to demonstrate these anatomical structures and oppose them accurately by buried suture

The anatomical type of operation is the only one worthy of consideration Buried sutures are harmless and enable one to coapt the different planes separately The puborectalis muscle plays back and forth on the urogenital trigone, therefore, through-and-through sutures including the trigone as well as the muscle would interfere with the free play of the above muscle Hence, such

the inner surface of the pelvic floor. The anterior fibers pass backward and downward until their termination they run between the external and internal sphincter to reach the fibrous tissue surrounding the anus. The remaining fibers of the ilococcygeus run backward to be inserted into the anococcygeal ligament and the sides of the coccyx. The ilococcygeus muscle is ensheathed by the fascia diaphragmatis pelvis superior and inferior which is continuous at the inner borders of the puborectal's. This fibrous envelop is derived from the oblique transverse fascia.

The pelvic diaphragm may be described as a muscular plate in which muscular action predominates. The puborectalis muscle draws the vagina and rectum forward and compresses them laterally. By virtue of its clamp like action on the anal canal is reduced to an anterior posterior slit. The levator ani muscle acts as a powerful sphincter since it surrounds the vagina like a loop. The anus is lifted up over the fecal mass in defecation by means of the levator muscle fibers which are inserted into the sphincter ani. A similar function is performed by the muscle in the act of parturition. The levator muscle as a whole supports all the pelvic structures.

The pelvic floor after removal of the pelvic organs resembles a funnel. The sides and posterior walls slope downward toward the anus which is the lowest point. Anteriorly the pelvic floor is nearly horizontal in the erect position and inclines downward being very slight. As a result of this conformation the intra-abdominal pressure is deflected forward by the sloping surface of the posterior portion of the floor and inward by the sloping lateral surfaces so that it falls on the plane surface of the anterior portion of the pelvic diaphragm in the middle line. The interval between the pubococcygeal tendon from the pubic arch back and behind the vagina. In addition the posterior attachment of the puborectal's muscle is noted so that this portion of the pelvic diaphragm operates under a decided mechanical advantage. Beneath the anterior plane surface of the pelvic diaphragm the urogenital triangle stretches across the pubic arch as a fibromuscular plate of great strength supporting the puborectalis which plays back and forth on it during action and quickly becomes stretched when the female is in the normal condition.

Relaxation of the pelvic floor would be the normal condition in some cases were it not for the urogenital triangle. Since the child must pass through the opening in this comparatively yielding structure laceration is of frequent occurrence and urgent repair is important.

The pelvic floor is perforated by the rectum, vagina, and urethra and each structure is closely connected to the floor in its passage through it. The rectum and vagina are provided with a sphincter below while the external sphincter of the female urethra is located in the urogenital triangle.

The sphincter apparatus is derived from the primitive sphincter cloacae from which originate the following muscles: the superficial transverse perineal, ischio-cavernosus, transverse perineal, profundus sphincter ani externus and internus, bulbocavernosus and sphincter urethrae. The sphincter ani muscle is of importance in connection with the present study since many of the fibers of the levator ani muscle are inserted and interconnect it. By means of the fibers the levator ani is able to elevate the floor of the pelvis.

The external sphincter ani muscle is one-half inch deep and encircles the anal canal. It consists of three strata: first a subcutaneous layer which decussates in front of and behind the rectum; second a superficial layer which arises by means of a fibrous spongy layer from the last bone of the coccyx and from the anococcygeal ligament.

Passing forward the muscle increases in size and at the posterior margin of the anus it divides into two halves which come in contact with either side with the lower part of the anal canal. At their insertion some of the fibers become tendons in the central point of the perineum others pass superficially toward the skin while many are continuous with the bulbocavernosus muscle and the deep external sphincter. A muscle forms an annular band of some thickness in continuity with the puborectal fibers of the levator ani. Its upper margin is not sharply defined because the fibers intermingle to a certain degree with those of the levator ani and the fibers of the two sides are continuous behind the rectum without being attached to the coccyx. In many cases the fibers of the deep division of the sphincter ani pass over to the opposite side in front of the anus and are attached to the ascending ramus of the ischium while other instances the fibrous tissue constituting the perineal body extend into the deeper layer of the sphincter and separate those fibers passing to the ischio-femoral space in contact with the rectum. The fibers which pass to the ischio-ramus represent the transverse perineal and obliquely the muscle is closely associated with the deeper layer of the external sphincter and may be regarded as a part of it.

Injury to the pelvic floor depends on the proportion existing between the size of the passage

obtained is found to be the muscle, which can be recognized by its vertical fibers and reddish color. The same procedure is carried out on the opposite side, but one should remember that the right levator is deeper than its fellow of the other side. The completed suture is now grasped by a forceps and sufficient length is left for tying the knot.

The assistant holds the suture upward and forward, and by this movement the right and left levator muscles are loosely approximated. Subsequent sutures are easily inserted. The needle enters the left muscle and then is brought to the midline, after which it enters the right muscle and the suture is completed. There is no rule for the number of sutures, however, a sufficient number should be used in order to give a proper approximation of the muscles. The number of sutures in the levator muscle varies from three to five.

When the lowest suture is passed through the levator muscle it should include a small portion of the fibers of the sphincter ani. Before tying, this suture should be held taut in order to see that the lowest portion of the levator is evenly approximated, and that a portion of it covers the sphincter and that any dead space is obliterated. There should be no variation in this part of the technique.

The index finger should now be inserted into the vaginal canal and with the thumb on the sutured muscles, the repaired structure can be palpated. The repaired muscles should have the same tension throughout. Additional sutures may be placed where tension is found to be unequal on the two sides. The highest suture in the muscle should not be tight enough to endanger the circulation in that area. If the top suture is too tight, it should be removed, and if too loose another one should be inserted above.

The urogenital trigone is found and sutured in a manner similar to the suture of the levator muscle. The upper part of the trigone just under the vaginal mucosa is about 1.5 centimeters deep, and gradually thins out as it approaches the rectum. It is identified by its thickness and glistening appearance. The first suture of the trigone is important. The needle should pierce the trigone at its upper part just under the skin at the junction of vaginal mucous membrane and vulvar skin. Then the needle should be turned inward toward the middle of the perineum and the suture completed. In this way a large bite of fascia is obtained and, when completed on the opposite side the levator muscle is sufficiently covered. Before tying, the suture should be held taut, as this demonstrates the amount of fascia in

its grasp and in addition displays the remainder of the trigone. Interrupted or continuous sutures may be used.

The skin is closed by a continuous mattress or subcuticular suture of plain catgut. The skin edges should be carefully approximated without too much tension in order to prevent wrinkling and eversion of the edges. A dressing is not needed.

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sutures should be discarded and layer sutures adopted in all cases

Laceration of the perineum did not escape the notice of Celsus but he had no remedy except securing the limbs to ether and bed rest. Pare recognized the injury and recommended suture. Mariceau did the same but there is no evidence that sutures were used. The first recorded case of perineal suture was that of Guillemeau. The laceration extended through the perineum and into the anal canal. In repairing this wound the raw edges were closed by a suture which was twisted over long needles placed in the perineum. Roux stated that there were no cases of this facty cure when the perineal laceration was left to nature. His method of repair consisted of appoximating the torn edges of the perineum by quilled suture aided by interrupted ones at a few intermediate points. Other contributors to the study of perineal repair were Rowley in England and Diefenbach and Oslander in Germany as well as Emmett and Sims in America.

In 1800 the secondary operation for incomplete laceration was done with a successful termination. Since these early times many operations have been devised for repair of the relaxed perineal floor.

The operation of perineal repair is done almost entirely by blunt dissection with a minimum of trauma and hæmorrhage. The operation is an anatomical demonstration of the pelvic floor structures the injuries of which are exhibited and corrected by suture. The field of operation is somewhat retracted however by following this technique the restoration of the perineal floor is easily and quickly accomplished. The essential instruments for this operation are a medium blunt pointed pair of scissors, a short tenaculum, a knife, needle holder, three straight forceps and round pointed full curve Mayo needles. The needle holder should have broad strong jaws so that the Mayo needle will be held firmly. If the needle holder does not grasp the needle steadily it may turn around in the depths of the wound and possibly puncture the rectum. In the following description reference is made to the right and left sides. Such terms apply to the right and left side of the patient which is in the lithotom position.

The operation is begun by grasping on both sides with tenacula the lateral vulvar structures at the level of the caudal myrtiformes. The assistant now pulls the tenacula forward and upward thereby making the perineum tense. An incision is then begun just below the vaginal fourchette and ends at the fibers of the pharynx. An incision is made with a sharp knife in the center of the

perineum. The depth of the incision should include the skin and Colles fascia. The tenaculum on the right side is released while the one on the left side is pulled directly forward. The operator places the left index finger in the left vaginal sulcus and presses backward toward the coccyx. Then the closed scissors are inserted in the upper portion of the median perineal incision and under the vaginal wall of the left side where they enter the loose connective tissue space between the vaginal wall and the fascia covering the levator ani muscle. The blades of the scissors are then widely opened and the vaginal wall is released from the underlying structures. At this time the left index finger is inserted in this dissected space in order to ascertain that the structures are free and that plenty of room is obtained. The dissection should extend upward to the junction of the lateral and anterior vaginal walls and posteriorly down and along the side of the rectum. The left index finger may be inserted in the space between the vaginal wall and the levator ani muscle and by placing the finger below the scissor blade when it is opened it is possible carefully to separate without injury the levator muscle from the rectum.

The same procedure is carried out on the opposite side. The right levator muscle is nearly always more widely retracted and there are usually adhesions which render the separation of the vaginal wall from the underlying fascia and muscle somewhat difficult.

By means of this dissection a large space has been made on both sides between the vaginal wall and the underlying fascia and muscle. Through this aperture the levator muscles can be easily palpated by thumb and index finger. The left levator is about centimeters deep and extends upward and outward along the outer wall of the opening. The muscle on the right side is palpated at a greater depth since its fascia has withstood more injury with the coincident muscle retraction. Hence more scar tissue is found on this side.

The tenaculum on the left side is now drawn forward and the operator places the index finger in the interval between the vaginal wall and the levator muscle pressing backward toward the coccyx. The maneuver places the levator muscle under tension. The needle passed into the upper third of the space taking care not to pick up the urethral trigone which is just in front of the levator muscle. The handle of the needle holder is then brought down right to a vertical position and by manipulation of the holder on its long anterior muscle picked up on the point of the needle. The suture is completed in the structure

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JANUARY, 1932

BURIED SKIN GRAFTS

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August Bier, of Berlin, who has had much experience with the method, considers its results surprisingly satisfactory, often superior to those of Thiersch grafting, and far better than can be obtained by means of superficial Reverdin grafts. The reasons for success are easily understood: the transplants, being buried, are surrounded on all sides by nutri-

tive material in abundance, they are protected from the infective agents abounding on granulating areas, they are undisturbed by the changing of dressings, by alterations in temperature, or by movements of the extremities, so that they even can be used in ambulatory clinics, they seldom fail to take, even among unhealthy granulations, hence a preliminary preparation may not be necessary, and strangely enough it does not seem to make much difference which side is uppermost. In the course of a week or two the superimposed granulations tend to disappear spontaneously, but when the grafts are too deeply situated for this to occur, the covering may be incised or gently scraped away.

Buried grafts appear to put a new aspect on the possibility of homografting or isografting, that is the grafting from one individual to another, about which there has existed for a long time much controversy. Erich Lexer, for instance, flatly states that 'homo-skin-grafting promises nothing and the trouble and suffering of the donor is without avail, the apparently successful cases being based upon faulty or too short observation', while John Staige Davis says with equal emphasis that "isografting is clinically possible and the results justify its use when autografting is not practicable."

While conceding that Lexer may have been more or less right regarding the older methods, Mannheim recently has achieved some remarkable results with buried grafts, which seem to throw a new light on the problem. With these his success was gratifying and not to be explained away by the growth of epithelium from the margins or from overlooked

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islands or chance implantations. His cases were followed up for long periods and the results found to be lasting. He even ventures to predict the success of zoo grafting by this method although the possibility of this has long been almost universally discarded.

Instead of using small bits of cuticle long narrow Thiersch grafts may sometimes be employed to advantage being woven in and out among the granulations or an epithelial paste procured by scraping the moist skin with a knife can be injected beneath the surface through a large hollow needle. The latter method is particularly useful in hollows and cavities which are difficult of access and where an inferior cosmetic result is unimportant.

Tunnel grafting (McLennan Keller) apparently is not employed as frequently as its usefulness deserves. In this procedure a number of tunnels are made with an appropriate scalpel close together from one side to the other through the tissues completely beneath a granulating area for instance an ulcer of the leg. Through these passages are inserted narrow full thickness grafts their ends projecting upon either side and owing to their protected and favorable situation good results are said to be obtained even in ambulatory cases where more superficial grafting would fail. Colonel W. L. Keller¹ has applied this method by an ingenious technique to the lengthening of contracted scars such as occur about joints following burns and operations.

Contrary to older ideas it has been found that skin can be successfully transplanted beneath the general cutaneous surface without giving rise to inflammatory reaction and has thus been employed for a variety of purposes such as suturing and patching of hernias the formation of artificial tendons and ligaments etc. Usually the grafts are prepared by shaving

off their epithelial surface but recently successful transplants of sterilized skin have been made without this preliminary. The procedure is especially appealing because abundant material can be obtained easily from the margins of a wound but it has not come into extensive use perhaps from fear of infection which however does not seem to be likely if sufficient care is used.

LEONARD FREEMAN

THE IMPLANTATION OF BILIARY FISTULAS

THE implantation of an external biliary fistula was among the early reconstructive measures employed to reestablish the flow of bile into the gastrointestinal canal. Czerny performed this operation in 1898. Unfortunately his priority in the use of the method was lost a bit of because his operation was called a cholangiohepatoenterostomy when the case was reported by Jordan in 1899 and by Merk in 1902. Merk in his report of Czerny's operation clearly described the implantation of an external biliary fistula by a technique which is similar to that employed today. Czerny dissected the fistulous tract through the abdominal wall. This dissected portion was trimmed off leaving a small projection at the edge of the liver. The portion of the fistulous tract attached to the under surface of the liver was left undisturbed. An opening accidentally made in the jejunum during the dissection was sutured to the capsule of the liver around the biliary fistula. Three days after the implantation of the external biliary fistula the patient died. At autopsy it was found that the patient had a carcinoma of the ampulla with metastases in the bile ducts. Czerny in doing this operation

M. K. Adams, B. E. P. d. Ch. der Californ.
San J. A. d. C. Eng. b. d. d. u. C. 90. x. 60.

originated the method of implanting an external biliary fistula into the gastro-intestinal tract. Recently there has been considerable interest in this procedure because of the relatively good functional results which have followed its use.

Von Stubenrauch, in 1905, attempted to implant an external biliary fistula. He dissected the fistulous tract down to its communication with the common bile duct, removing it from its attachment to the under surface of the liver. He then implanted it, including its external orifice, into the pylorus. Unfortunately, the fistulous tract necrosed because it had been deprived of its circulation when it was dissected from the liver. Consequently the method failed in this particular instance, and another reconstructive measure was later carried out. An implantation of an external gall-bladder fistula into the pylorus was reported by Mariam in 1912. The patient was well two years after the operation. This was the first implantation following which there was a successful functional result.

No report of an implantation of an external biliary fistula was made in America until 1918, when Eliot recorded an operation performed by F. T. Murphy. The patient had a biliary fistula with a double external orifice. At operation Murphy found that deep within the abdomen, the tract ran parallel and adjacent to the superior portion of the common bile duct. He prepared the inferior portion of the duct for anastomosis, and trimmed off the double portion of the fistulous tract. The remaining portion of the fistula he telescoped into the prepared end of the duct. The patient was well for six months but later became jaundiced and died. Here again it is quite probable that failure resulted because the circulation to the fistulous tract was impaired by dissecting it from the liver. The next case to be reported in America was by

Collins in 1919. He operated upon a patient who had an external biliary fistula, following a cholecystectomy and a choledochotomy. Collins found the fistulous tract emerging from between the closely adherent liver and duodenum. He dissected the fistulous tract from the abdominal wall, inserted a rubber drainage tube into its lumen and implanted the biliary fistula with the projecting tube into the duodenum through a Witzel fistula. Eight months after the implantation, when the case was reported, the patient was well.

Williams implanted an external biliary fistula in 1913, but the operation was not recorded until Lahey reported it in 1923 together with a case of his own in which he had used a similar procedure. Williams did not report the case himself until 1929. His patient at the time of operation was a boy five years of age, who had an external biliary fistula of one year's duration, following the drainage of a cyst of the liver. At the reconstructive operation Williams removed the gall bladder and the cystic duct and then dissected and prepared the fistulous tract for implantation. He incised the duodenum and anastomosed the end of the fistulous tract to the duodenal incision. The new communication functioned successfully, and when Williams reported his case in 1929, sixteen years after the implantation, the patient was well and had had no return of jaundice.

Lilienthal, in 1923, Roith, in 1924, and St. John, in 1926, each reported a case in which an external biliary fistula was implanted into the stomach with satisfactory results. Lilienthal's patient was well two months, Roith's, one month, and St. John's, twenty-one months after operation when the reports were published. Whipple, in 1927, recorded two cases in which death followed the implantation of an external biliary fistula into the stomach. In one case the patient died within twenty-

four hours from cholæmia in the second case the fistulous tract was impaired during its dissection and a gastric fistula formed resulting in peritonitis and death. Masson and Walters at the Mayo Clinic have each implanted external biliary fistulas. Masson in two instances and Walters in five. The immediate functional results were good in both of Masson's cases but failure resulted later in one case. Excellent functional results followed the implantation in four of Walters' cases. Recently Lahey has reported a series of ten implantations of external biliary fistulas into the stomach or duodenum. Satisfactory functional results followed six of the operations, failure two and death two.

An indirect implantation of an external biliary fistula into the stomach was recorded by Wilms in 1911. A rubber drainage tube was used to bridge a gap between the fistulous tract and the stomach. The patient was well for four months when she vomited the drainage tube and bile ceased flowing into the gastro intestinal tract. At a subsequent operation the same method of indirect implantation was again used. The patient was well following the second operation when Wilms reported the case but Wilms did not state how much time had elapsed.

With implantation of an external biliary fistula an established method of restoring the

flow of bile into the gastro intestinal tract the technical points which make for its success should be borne in mind when the operation is contemplated. Naturally the method can be used only in cases in which an external biliary fistula exists or in which a fistula can be purposefully made. The fistula must be well established, well vascularized and must adequately drain the biliary tract. It is important that the circulation of the fistulous tract remain unimpaired. Therefore the tract should be cored out of the abdominal wall in a thick cylinder of tissue, the lumen of the tract should not be opened in the dissection and its attachment to the under surface of the liver should not be disturbed. In preparing the tract for implantation the external orifice with a small portion of the fistula is trimmed off leaving a portion of the tract projecting beyond the edge of the liver. A small opening is made in the stomach, duodenum or jejunum and this opening is sutured to the under surface of the liver near its edge around the fistula. Where these points have been observed the functional result has usually been satisfactory. When an external biliary fistula exists the implantation of the fistulous tract into the gastro intestinal tract should because of its simplicity be considered rather than a more difficult and less feasible method.

EDMUND HORGAN

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EDWARD HORGAN



ALBERT VANDER VEER
84 -1929

MASTER SURGEONS OF AMERICA

ALBERT VANDER VEER

ON July 10, 1841, Dr Albert Vander Veer was born in Root Montgomery County, State of New York. His ancestors on his father's side came from Alkmaar, Holland, in 1659, and settled first at Flatbush, Long Island. Later on some of the family emigrated to the Mohawk Valley, and it is from this branch of the family that Dr Vander Veer was descended.

His early education was acquired in the district school and very early in his life he manifested his liking for the study of medicine. He began his medical studies with Dr Simeon Snow, who was a typical country practitioner of the middle part of the nineteenth century. Incidentally Dr Snow was the father of a very pretty daughter who subsequently became the wife of Dr Vander Veer. That Dr Vander Veer was interested in his profession is shown by the fact that he walked three miles every morning from his father's farm to the doctor's office and back again at night. The fall and winter of 1861-1862 was spent as a student of Dr John Swinburn of Albany, New York, one of the most noted surgeons of his day, and it was undoubtedly this association which turned the young student's later career to surgery. At this time the Civil War had broken out and he was appointed one of the original one hundred medical cadets from the State of New York and stationed at a military hospital in Washington, D C. The duties of these cadets were those practically of internes, and by working late at night and early in the morning, it was possible for Dr Vander Veer to attend lectures, from two to eight in the afternoon, at the Columbia Medical College. Immediately upon receiving his degree he was appointed assistant surgeon and later, surgeon, with the rank of major of the Sixty-sixth Regiment New York Volunteers. He was present at Appomattox and at the historic meeting of Grant and Lee, and wrote and spoke frequently of it in his later years. At the conclusion of the War he took a course of lectures in New York City and commenced the practice of medicine and surgery in Albany in May, 1866.

As was the custom in those days he practiced both medicine and surgery. At once he developed a large practice, but early manifested his ability in surgery and gradually withdrew from his medical work though he retained some of his first medical families up to the end of his career. He was appointed professor of general and special anatomy in the Albany Medical College, in 1869, subsequently

being transferred to the chair of surgery which latter position he held until his retirement in 1914

He was also attending surgeon to the Albany Hospital from 1860 till his retirement. In 1875 when the hospital was about to close owing to its heavy debt he was largely instrumental in raising that debt so that the institution continued. Again in 1897 when it became apparent that the hospital had outgrown its physical equipment he headed the group which raised the money for the new hospital and the new buildings were built largely upon his plans.

He was very fond and proud of seeing his students progress and nothing gave him greater pleasure than to have one of his old students return and tell him of his success in the practice of medicine and surgery. In 1904 his old students gave him a testimonial dinner at which time they presented him with a loving cup suitably engraved which he cherished to the last.

The year 1873-1874 was spent in study abroad. This was the period at which our present surgical technique was being developed and he came back from that trip full of enthusiasm and eager to put the new ideas which he had learned in practice to work. This enthusiasm never left him and he was ever ready to try out new ideas and operations. He was never content to stand still; he was always progressive and kept up with the advances in surgery and if possible was a little ahead of them.

He was an omnivorous reader and even up to the last few months of his life he never neglected his medical journals and would try and very often succeed in confounding his sons by asking in a very innocent way about some new medical theory which they had never heard of but which he had just read about.

He was honored by his medical confreres by being elected president of his county and state medical societies, president of the American Surgical Association, president of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons and in 1916 was president of the American Medical Association, succeeding to that office by reason of the death of Dr. Rodman, the president for that year.

Dr. Vander Veer was interested outside of his profession in all civic affairs that made for the good of his community, especially that of education. He was a regent of the University of the State of New York, the Educational Department of the State for 32 years with the exception of one year being elected regent first in 1805 and retiring in 1907 due to advancing years. He was vice-chancellor from 1904 to 1907 and then chancellor for a few months but resigned the position due to impaired hearing. He was an ex-president of the Holland Society of New York and had been decorated with the Order of Orange Nassau by the Queen of Holland. He was a vice-president of the Albany Institute of Art for over thirty years.

He was of a religious nature and had been an Elder in the First Presbyterian Church for more than 40 years and a commissioner to its General Assembly

A good share of his later years was passed at his Adirondack Camp where he liked to farm on a small scale and also attend to the cutting of wood and the burning of it in his fire places

Dr Vander Veer enjoyed good health up to the end and passed quietly away without pain, at his Albany home December 19, 1929

He left three sons, all of whom are physicians, and six grandchildren, one of whom is also a physician

EDGAR A VANDER VEER

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

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us a resume of the general consensus of opinion and after that the conclusions they have reached on the basis of their actual experience. The book is written in clear, simple German, which is a blessing for the American surgeon. Material is easily available, the illustrations are excellent, and the type is clear. The point of view of the authors is most sane, leaning to conservatism.

RALPH B. BETTMAN

IN this book¹ on the causation of chronic gastroduodenal ulcers, Spira attempts to postulate a new physiological principle which explains the occurrence of chronic peptic ulcers as opposed to acute ulcers. The author states "the acute and chronic ulcer have nothing in common, the acute one never becomes chronic and *per contra* the so called chronic one never assumes the acute form in spite of a recrudescence of activity." Spira explains the formation of a chronic ulcer on the basis of a local irritation (not hydrochloric acid) acting continuously or intermittently, thus accounting for the peculiar clinical story. The causative factor, which is often present for a long period of time before the appearance of the ulcer, is accompanied by gastritis, pylorospasm, and hyperchlorhydria.

The cause of the irritation is built upon the hypothesis that some bile constituents act, in an acid medium, as powerful irritants to the pyloric mucosa. The presence of fat in the stomach delays the evacuation of the stomach contents and stimulates the secretion of bile in the liver and hydrochloric acid in the stomach, at the same time it causes duodenal regurgitation into the stomach (not present under ordinary circumstances during normal digestion) with prolonged irritation of the pyloric mucous membrane and consequent pylorospasm and hypertonus. Fatty acids and soaps form an additional irritation.

In consequence of this theory, the cure depends, almost entirely, upon a suitable diet which must exclude fats. Unfortunately, no detailed plan is presented for either the prevention or cure of ulcer.

No doubt the average reader will be skeptical, nevertheless the sound reasoning employed in the construction of the hypothesis and the uniformly satisfactory clinical results obtained by the author in the treatment of peptic ulcer over a period of 10 years warrant further study of the hypothesis. The medical profession welcomes a new approach to the subject of peptic ulcer.

J. A. WOLFER

THE constantly widening interest in lesions of the anorectal region is being met by a decided increase in the number of contributors to the literature on the subject. When one attempts, as has Dr. Pruitt in his recent book,² to discuss every phase of the field in a treatise of 370 pages, some of the chapters will necessarily be somewhat sketchy. The wis-

dom of dismissing diverticula, for example, in two pages, or injuries and foreign bodies after a consideration on one page each is open to question.

The reviewer would have welcomed a more detailed discussion of the use of low spinal anesthesia in proctology since the opinion is now widely held that it is particularly well adapted to surgery in this zone, and no mention is made of intravenous medication in anal chancre, which has in many localities supplanted the old treatment by escharotics and surgery.

The chapters on anatomy, embryology, fistula, and hemorrhoids are concise and well written and the thirteen pages describing the use of injections in the treatment of piles will intrigue the general practitioner.

The newcomer in the specialty will find in the book a readable introduction to the subject, those already familiar with its principals will credit the author with an extensive knowledge of recent literature, from which he has quoted freely and with a nice discrimination to supplement his own mature experience.

CURTIS ROSSER

IN a volume³ of 180 pages Ivy and Curtis describe the methods of treatment of fractures of the jaw which in their hands have, during many years experience, proved most successful. The book will prove of value especially to the surgeon or dentist who, for the first time, is called upon to treat fracture of jaws or even to administer first aid. Too frequently, however, a fractured jaw is improperly treated or neglected for a few weeks, when simple methods such as outlined in this book are no longer applicable. The crux of the treatment of fractures of the jaws is in the reduction of the fracture and its maintenance in normal position by means of wires which hold the teeth in the same relation to each other as they were before the fracture occurred. (This of course, must be realized before the wires are applied.) The manner of application of the wires advanced by the authors is simple and expeditious. It is particularly gratifying to note the contra-indication to open operation in fractures of the neck of the condyles, either with or without dislocation of the head, which is mentioned in the text, but not sufficiently stressed.

The retraction of the posterior fragment by a wire through the angle fixed to the back of the neck or plaster head cap is good. The manner of applying a plaster head cap used to maintain traction in other ways, will be helpful to the uninitiated.

HERBERT A. POTTS

THE very elaborate treatise⁴ on mouth diseases by Goadby contains 460 pages with 145 illustrations, many of them in color and selected from the

¹THE CAUSATION OF CHRONIC GASTRO-DUODENAL ULCERS. A NEW THEORY. By J. Jacques Spira M.R.C.S. (Eng.) L.R.C.P. (Lond.) With an introduction by Sir Humphrey Rolleston Bart. G.C.V.O. K.C.B. New York and London Oxford University Press 1931.

²MODERN PROCTOLOGY. By Marion C. Pruitt M.D. L.R.C.P.S. (Ed.) F.R.C.S. (Ed.) F.A.C.S. St. Louis The C.V. Mosby Company 1931.

³FRACTURES OF THE JAWS. By Robert B. Ivy, M.D. D.D.S. F.A.C.S. and Lawrence Curtis A.B. M.D. D.D.S. Philadelphia Lea & Febiger 1931.

⁴DISEASES OF THE GUMS AND ORAL MUCOUS MEMBRANE. By S. A. Goadby K.B.E. M.R.C.S. L.R.C.P. D.P.H. (Cantab.) New York and London Oxford University Press 1931.

methods. A bibliography is inserted at the end of the book. In a work of this scope obviously not all procedures in common use can be described. Selection is made on the basis of general usage and personal preference. The van den Bergh test for bile pigments in the blood is dismissed as of questionable value, the Hinton test for syphilis is not mentioned, microchemical methods of examination of capillary instead of venous blood are omitted.

The new third edition contains numerous additions, such as the Kline reaction for syphilis, the Newcomer method for determining hæmoglobin content of the blood, the icterus index, and the use of histamine in studying hydrochloric acid secretion by the stomach.

This manual remains one of the best available to the student and laboratory worker.

WALTER H. NADLER.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THEORIE UND PRAXIS DER KREBSKRAKHEIT. By Privatdozent Dr. Felix Mandl. Vienna: Wilhelm Maudrich, 1932.

FOPTSCHRIKTE AUF DEM GEBIETE DER ROENTGENSTRAHLEN. Edited by Prof. Dr. Grashey. Vol. 37. DIE HARNORGANE IM ROENTGENBILD. By Prof. Dr. Eugen Joseph and Dr. S. Perlmann. 2d revised edition. Leipzig: Georg Thieme, 1931.

AN INTRODUCTION TO THE LITERATURE OF VERTEBRATE ZOOLOGY, Based chiefly on the titles in the Blacker Library of Zoology, The Emma Shearer Wood Library of Ornithology, The Bibliotheca Osleriana, and other libraries of McGill University, Montreal. Compiled and edited by Casey A. Wood, M.D., LL.D. London: Oxford University Press, 1931.

MATAS BIRTHDAY VOLUME, A COLLECTION OF SURGICAL ESSAYS WRITTEN IN HONOR OF RUDOLPH MATAS, NEW ORLEANS. New York: Paul B. Hoeber, 1931.

RADIO-THERAPIE, TECHNIQUE DU DOSAGE EN PROFONDEUR. By Ch. Guibert. Paris: N. Maloine, 1932.

WEIT'S HANDBUCH DER GYNAEKOLOGIE. Edited by Dr. W. Stoeckel. Vol. 11, 1st half. DIE PHYSIKALISCHE THERAPIE IN DER GYNAEKOLOGIE. Edited by A. Laqueur, W. Rump, H. Wintz. Munich: J. F. Bergmann, 1930.

ANNALS OF ROENTGENOLOGY, A SERIES OF MONOGRAPHIC ATLASES. Edited by James T. Case, M.D. Vol. XIII. GYNECOLOGICAL ROENTGENOLOGY. By Julius Jarcho, M.D., F.A.C.S. New York: Paul B. Hoeber, Inc., 1931.

BIOLOGIA Y PATOLOGIA DE LA MUJER, TRATADO DE OBSTETRICIA Y GINECOLOGIA, publicado bajo la dirección de los Doctores Joseph Halban y Ludwig Seitz. Traducido directamente del original alemán por Joaquín Núñez Grimaldos con la colaboración técnica del Dr. D. Arcadio Sánchez López. Tomo VIII. Madrid: Editorial Plus Ultra, 1931.

MIDWIFERY. By Ten Teachers, under the direction of Comyns Berkeley, M.A., M.D., M.C. (Cantab.), F.R.C.P. (Lond.), F.R.C.S. (Eng.), F.C.O.G. Edited by Comyns Berkeley, J. S. Fairbairn, Clifford White. 4th ed. New York: William Wood & Company, 1931.

ASSOCIATION FRANÇAISE POUR L'ÉTUDE DU CANCER. ATLAS DU CANCER. Vols. IX and X. Les Tumeurs des Centres nerveux et des Nerfs périphériques. By Gustave Roussy et Charles Oberling. Fondation Henri de Rothschild. Paris: Librairie Félix Alcan, 1931.

CORRESPONDENCE

THE SURGICAL TREATMENT AND MANAGEMENT OF PHARYNGOESOPHAGEAL DIVERTICULUM

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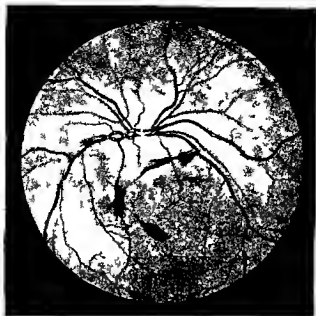


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HÆMORRHAGIC RETINITIS IN VOMITING OF PREGNANCY

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THE etiology of vomiting of pregnancy is still unknown. From the evidence to date it appears that a metabolic disturbance, particularly in the carbohydrate chain, may perhaps be an important etiological factor. Dehydration, starvation, and incomplete oxidation of fatty acids certainly play an important rôle in the production of the chemical changes noted in the blood and urine of a patient suffering from severe vomiting of pregnancy. These abnormal findings are usually a high ammonia nitrogen content in the urine, and a slightly increased non-protein nitrogen, decreased chlorides, increased uric and lactic acids, and accumulation of acetone bodies in the blood.

In many fatal cases of vomiting of pregnancy, characteristic lesions are present in the liver, which show as profound necrosis of the central portion of the lobule. Although many writers regard this lesion as characteristic of vomiting of pregnancy, it is conceivable that starvation, rather than the vomiting of pregnancy, may be the underlying cause of these hepatic lesions. On the other hand, we know from the work of Opie and others that central and midzonal necroses in the liver are usually the result of systemic poisoning, from which it would appear that vomiting of pregnancy may rest on a toxic basis.

Mack suggested that a toxin or poison produced by the fetus or placenta may be the cause of vomiting of pregnancy, and that normal pregnant women become immune to this toxin. No such toxin has, however, been isolated, and, it is conceivable that it may prove to be an intermediate or end-product of metabolism, rather than a foreign poison. It certainly seems that the neurotic element, as a factor in the etiology of the

disease, has been greatly overemphasized in the past. All cases of vomiting of pregnancy are undoubtedly toxæmic in origin, although they may vary greatly with respect to the rôle which a neurosis may play in the course and prognosis of the disease.

We have been unable to find in the literature any reference to hæmorrhagic retinitis associated with vomiting of pregnancy. Recently we studied two such patients, and since the findings may be additional information in the search for the cause of this disease, they are here reported in some detail.

CASE 1 The first patient, a colored secundigravida, age 32 years, was admitted to the hospital March 3, 1931, having had her last menstrual period October 10, 1930, and complaining of severe vomiting. According to her history she had lost 26 pounds in weight during the 2 months preceding admission to the hospital. Physical examination showed some dryness of the skin, noticeable emaciation, but no jaundice. She was 5 months' pregnant and suffering from severe vomiting, which persisted in spite of treatment. Isolation, fluids, intravenous glucose solution, and small meals were of no avail. Nine days after admission the patient complained of blurred vision, and ophthalmological examination at that time revealed the fact that the discs were normal but that they were surrounded by several large areas of hæmorrhage. These hæmorrhages, which were present in both eyes, were retinal and subhyaloid in distribution, varying from a pin point to large patches. There was no arteriovenous compression and the arteries appeared to be quite normal except for some crinkling of the very small branches. No exudates or oedema could be detected. The impression was that the patient had hæmorrhagic retinitis with no obvious disease of the vessels of the retina.

The patient's condition became steadily worse, as indicated by the persistent vomiting, steady loss of weight and the development of partial blindness. Administration of intravenous glucose solution was continued, but failed to produce any improvement.

TABLE I—URINE AND BLOOD CHEMICAL ANALYSES, CASE 1

Date	Urine				Blood						Remarks
	Acetone	Diabetic	Urea N %	NH ₃ %	N P %	Urea N	Uric Acid	Chlo de	Suga	CO	
3-3-31	0	0	74.5	5.0	14.5	18.0	4.2	4.9	5.0	50.0	Admitted to hospital
3-5-31	—	+			0.5		4.4		8.0	52.2	Fluid by mouth
3-7-31	0	0			0.8		5.3		96	55.7	Condition worse
3-11-31	0	0			3.3		4.5		1.1	51.9	Blurred vision appeared
3-14-31	0	0			50.0		4.7		164	54.7	Intravenous glucose
3-15-31	+	—			30.9		4.1	4.5	18	54.7	Slightly improved
3-18-31	+	+			39.5		5.7	4.7	750	59.0	Intravenous glucose
3-19-31	+	+		6.5			6.8		790	54.3	Pregnancy terminated
3-20-31	+	—	68.5		53.6	30.0	10.4	383	400	51.0	Lactic acid 60 Amino acid. 50 Died 3 p.m.

TABLE II—URINE AND BLOOD CHEMICAL ANALYSES, CASE 2

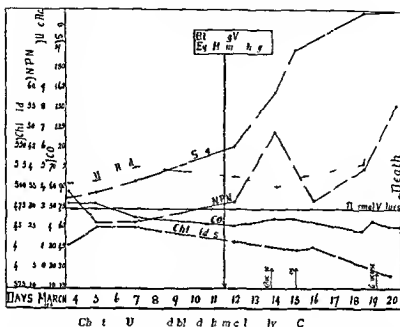
Date	Urine				Blood						Remarks
	Acetone	Diabetic	Urea %	NH ₃ %	N P %	Urea %	Uric Acid	Chlo des	Sugar	CO	
6-2-31	—	—	68.8	8.8	38.9	0.5	4.4	4.5	119	55.5	Admitted to hospital
6-7-31	+	+			23		4.1	465	97	50.9	Slightly improved, fluid by mouth and infusion
6-30-31	—	—			2.8		4.4	455	84	37.2	Headache
7-1-31	+	—			18.0		1.5	495	68	51.0	Blurred vision hæmorrhagic retinitis
7-3-31	+	—			20.0		1.8	400	75	50.0	Pregnancy terminated
7-7-31	0	0			26.0		1.1	555	103	46.6	Improved intravenous glucose
7-11-31	0	0			28.8		1.5	470	77	48.5	Improving steadily
7-16-31	0	0			30.6		2.5	490	71	56.9	On ward diet
7-18-31	0	0	78.9	3.4	31.0	14.8	2.5	495	78	57.0	Discharged well

nior lobe of the pituitary gland. There is no very good explanation for the hypophyseal necrosis other than that some unknown poison or toxin or metabolic product, associated with the toxæmia of vomiting of pregnancy, had caused the necrosis in both liver and hypophysis. It is interesting to note that in this patient there was a hyperglycæmia, and it is conceivable that the high blood sugar might have been associated with the lesion in the hypophysis. We have previously noted similar lesions in the pituitary gland in 2 fatal cases of vomiting of pregnancy, 2 cases of eclampsia, and 1 case of chronic nephritis during pregnancy.

It seems logical to assume that the hæmorrhagic retinitis is associated with, and a result of, the vomiting of pregnancy toxæmia. This appears to be substantiated by the fact that the retinitis cleared up in the second patient, in whom termination of pregnancy was done early enough to bring about complete recovery. From our experience in

these 2 cases, the appearance of hæmorrhagic retinitis in patients suffering from vomiting of pregnancy must be regarded as a grave prognostic sign and an absolute indication for immediate termination of pregnancy. Routine and repeated ophthalmological examinations in all patients suffering from vomiting of pregnancy seems essential. Attention should also be paid to any complaints of disturbed vision.

From a study of the drawings of the eye-grounds as shown in Figures 1 and 2 (frontispiece), it is apparent that the hæmorrhages are of a diffuse character and quite different from the hypertensive or arteriosclerotic type. One gains the impression that there is an escape of blood cells or diffusion of blood elements through the capillary walls due to injury to, or change in permeability of, these vessel walls. The liver lesion, the necrosis in the hypophysis, as well as these changes in the capillary walls may be due to a single agent or substance, toxic in character.



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CLINICAL AND EXPERIMENTAL BASIS FOR SURGERY OF THE PELVIC SYMPATHETIC NERVES IN GYNECOLOGY

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Clinique Chirurgicale A (Professor Leriche) Université de Strasbourg

FUNCTIONAL disturbances of the pelvic sympathetic nerves are frequently responsible for severe intractable dysmenorrhœa from which relief is rarely obtained by the ordinary methods of treatment. These functional or intrinsic types of dysmenorrhœa together with the severe neuralgias associated with inoperable neoplasms in the pelvis offer an important field for surgery of the pelvic sympathetic nerves.

In 1898, Jaboulay attempted to relieve pelvic neuralgia by interrupting the afferent pathways in the sacral sympathetic chains. In one patient he disarticulated the coccyx, then, after freeing the rectum from the hollow of the sacrum, he was able to resect a small portion of the sacral sympathetic chain of one side and divide it on the opposite side. In the second patient he freed the rectum from the hollow of the sacrum and displaced it anteriorly with the hope of pulling apart the anterior branches of the sacral plexus. These operations, however, were successful only in relieving the pelvic neuralgia for a short time. About one year later, Ruggi published his interesting work on abdominal sympathectomy in functional disturbances of the female genital organs. He advised the resection of the utero-ovarian plexus by the transperitoneal route. His reports show that the operation was frequently followed by a complete disappearance of the pelvic pain. Nevertheless, the work of both Jaboulay and Ruggi failed to hold the attention of the other surgeons of that time and, as a result, these procedures were quickly discarded and forgotten.

In 1921, Professor Leriche made a complete study of the pelvic sympathetic nerves in relation to pelvic neuralgia and he introduced the per-arterial sympathectomy of the internal iliac (hypogastric) artery as a means of relieving the pain in cases of functional dysmenorrhœa. This procedure was widely accepted in Europe and from the results published by Leriche, Cotte, Hallopeau, and

Michon, the operation gave complete and lasting relief from pain in the great majority of the cases. In 1925, Cotte found that section of the superior hypogastric plexus (presacral nerve of Latarjet) also gave complete relief in cases of functional dysmenorrhœa. Since the section of the superior hypogastric plexus proved to be much simpler from the technical standpoint he suggested it as a substitution for the more complicated operation of per-arterial sympathectomy of the internal iliac (hypogastric) artery.

The very gratifying results that have been obtained by the various operations upon the pelvic sympathetic nerves for the relief of pelvic neuralgia seem to us to justify this present work. However, before entering into the details of the surgery of these nerves it will perhaps be wise to review briefly the anatomy and physiology of the entire pelvic sympathetic nervous system.

MACROSCOPIC ANATOMY OF THE NERVES TO THE FEMALE SEX ORGANS

The innervation of the ovary. The ovary derives its nerve supply mainly from the ovarian plexus. This plexus arises from the intermesenteric and renal plexuses and follows the ovarian artery throughout its entire course (Fig 1). According to Hovelacque three fibers arise from the middle of the renal plexus to join the ovarian plexus. Petit-Dutailis and Flandrin (1923) have also demonstrated fibers arising from the lateral edge of the renal plexus. These fibers unite with the fibers from the intermesenteric plexus. As early as 1783, Walter demonstrated ganglion cells interposed between these fibers. The number of the fibers is not constant, occasionally, however, they are so numerous as to form a true plexus. Hovelacque states that this group of nerves is usually combined into a single or at the most, two main nerve trunks. Dahl (1924) and Laux (1927), however, represent them as a true plexus formation.

CONCLUSIONS

1 Hæmorrhagic retinitis appearing during the course of vomiting of pregnancy is of grave prognostic significance and an indication for therapeutic abortion

2 Routine and repeated eye ground examinations should be conducted on all patients suffering from severe vomiting of pregnancy

3 The character of the hæmorrhagic retinitis seen in 2 cases of vomiting of pregnancy makes it

probable that the eye lesion is caused by a change in the permeability of the capillary walls

4 Necrosis in the anterior lobe of the hypophysis is sometimes seen in fatal cases of vomiting of pregnancy

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pictured these fibers as united into a single nerve trunk, consequently, they gave it the name of "pre-sacral nerve." Numerous studies have been carried out to clarify this question, but in spite of all of the work the facts are still contradictory. Ferey (1926) found a single nerve in only 15 per cent of the 13 dissections which he made. A definite plexus formation was found in the remaining 85 per cent of his dissections. In a series of 80 dissections, Delmas and Laux (1927) found that in 20 per cent of the cadavers the roots were joined together thus forming a true nerve, while in the remaining 80 per cent of the cadavers the nerves were more or less spread out in a plexus formation. Roussel (1926), on the contrary, found a single nerve in 75 per cent of his dissections, a plexiform formation in 20 per cent, and a true plexus with broad meshes in only 5 per cent of the dissections. It has been our experience that the nerves are usually in a plexus formation and rarely combined into a single nerve trunk. In introducing the section of the superior hypogastric plexus into gynecological surgery, Cotte (1925) accepted the description of Latarjet and Bonnet (1913) and consequently named the operation the "section of the presacral nerve." This name has remained prevalent in France so that we shall make use of it frequently throughout this work but only with the understanding that we do not refer to a single nerve trunk but to a variable number of filaments of a great plexus formation.

A few nerve filaments from the superior hypogastric plexus course along the common iliac arteries. The plexus itself continues down over the promontory of the sacrum and at about the level of the first sacral vertebra divides into two distinct nerves called the *inferior hypogastric nerves* (Fig. 3). Delmas and Laux (1927) describe this division as taking place just above the promontory of the sacrum.

The inferior hypogastric nerves. These nerves are usually between 2 and 3 inches in length and course obliquely from above downward in the lateral rectal space. They course along the internal iliac arteries and give off branches which accompany the branches of these arteries, other branches course medially and

terminate in the rectum. The lateral sacral vessels lie slightly medial and posterior to these nerves (Latarjet and Rochet, 1922). The principal ureteral nerves are derived from these inferior hypogastric nerves. After these branches have been given off, the two inferior hypogastric nerves terminate in a mass of nerve fibers and ganglion cells which has been named the *hypogastric ganglion* (Fig. 5) by Lee (1849) and Frankenhaeuser (1867). The actual existence of such a ganglion is debatable. Hovelacque (1927) has defined the "so called ganglion of Frankenhaeuser" as the anterior part of the inferior hypogastric plexus. Dahl (1916) made an histological study of that part of the plexus and he was able to demonstrate occasional masses of ganglion cells within the meshes of the nerve fibers. Lee (1849), Frankenhaeuser (1867), Robinson (1894), Hashimoto (1904), Jung (1905), and Kehr (1910) have all considered it a true sympathetic ganglion. Latarjet and Rochet (1922) have described the ganglion as a greyish-white felting in the form of a quadrilateral mass the limits and dimensions of which are difficult to fix. The inferior hypogastric nerve is continuous with the medial surface of this mass. The visceral branches to the pelvic organs are derived from the medial surface of the mass while there is a rich anastomosis with the sacral nerves on the lateral surface. The entire mass of ganglion cells and nerve fibers which make up this hypogastric ganglion is situated in the superior pelvic space between the peritoneum and the fascia covering the levator ani muscles. The plexus reforms on the anterior surface of the rectum just posterior to the uterus and vagina and becomes intimately connected with the uterosacral ligaments. Blasdel (1917) has studied this connection and believes it to be a most important formation. Between the lateral border of the hypogastric plexus and the levator ani muscles are situated the internal iliac vessels. These large vessels are separated from the plexus by the thin genitopelvic aponeurosis. The uterine artery passes over the anterior surface of the plexus. Condamine (1927) has recently revived the old procedure of cutting the uterosacral ligaments for the purpose of relieving pelvic pain that is asso-

The ovarian plexus enters the suspensory ligament of the ovary and divides into an external tubular branch which supplies the fallopian tube and one or several internal branches which go to the hilum of the ovary. Five or six terminal filaments of the external tubular branch course through the broad ligament and reach the lateral border of the uterus (Fig. 2). According to Lhermitte and Dupont (1925) Segond (1906) and Hovelacque (1927) there is no anastomosis between these filaments and the plexus of nerves which accompanies the uterine artery and its branches. Morrison Lacombe (1920) on the contrary states that there is an anastomosis between these fibers.

The innervation of the uterus. The nerve fibers in the wall of the uterus are derived from the great plexuses of Frankenhaeuser (1867) which are situated on either side of the body of the uterus in the broad ligament. These plexuses are made up of fibers from both the hypogastric and sacral plexuses. The hypogastric plexus (Fig. 3) is arbitrarily divided into two parts, the inferior part being called the inferior hypogastric plexus and the superior part the part which has been given so many special names is now commonly called the superior hypogastric plexus. Some of the special names that have been applied to the superior hypogastric plexus in the past are plexus sous-mésentérique (Winslow, 1732), nervus uterinus magnus (Tiedemann, 1822), nexus ganglionnaire lamelliforme (Bourguery, 1844), plexus uterinus magnus (Frankenhaeuser, 1867), plexus interiliaque, nerf pré-sacré (Latarjet and Bonnet, 1913) and nerf prélobaire (de Pouville, 1927).

The superior hypogastric plexus has been described by Hovelacque as essentially a continuation of the intermesenteric plexus below the inferior mesenteric artery and it includes that portion of the plexus which extends from the superior part of the fourth lumbar vertebra to the middle of the first sacral vertebra. There it divides into two terminal plexuses called the right and the left *inferior hypogastric plexuses* (Fig. 4). Delmas and Laux (1917) state that the important branches to this plexus come from the lumbar sympathetic chains. They also believe that the fibers from the first and second lumbar ganglia are the

principal roots which strengthen the thin branch from the inferior mesenteric plexus and the branches from the third and fourth lumbar sympathetic ganglia. These roots make up the *superior mesenteric plexus* similar to the manner in which the splanchnic nerves are formed consequently the branches are frequently referred to as the pelvic splanchnic nerves.

The terminal branches of the intermesenteric plexus unite in an extremely variable way to form the superior mesenteric plexus. Ganglion cells have been demonstrated in the plexus formed by these branches consequently the point of convergence of the roots has been given the name of the inferior mesenteric ganglion.

The *inferior mesenteric plexus* gives rise to the right and left mesenteric nerves. The nerves unite at a point about 1 inch below the origin of the inferior mesenteric artery to form the beginning of the *superior hypogastric plexus (presacral nerve)*. The branches from the left side pass obliquely downward while the branches from the right pass posterior to the artery. There are usually many fine anastomoses between these nerves so that a true plexus is formed. This plexus is situated just anterior to the bifurcation of the aorta and separated from it by a thin layer of fascia. The plexus then follows the curve of the sacrum into the pelvis. There is usually a slight deviation of the plexus to the left. The midsacral artery is separated from the posterior surface of the plexus by a dense layer of fascia. Anteriorly the plexus is covered by a thin layer of loose connective tissue and the parietal peritoneum. In this individual the superior hypogastric plexus can easily be seen through the peritoneum. The root of the mesentery of the sigmoid colon is situated to the left.

There are many slight variations of the superior hypogastric plexus but none of them is of very great importance. Poussel (1926) made a very complete study of these variations. All of the recent studies especially those of Segond (1906) and Hovelacque (1927) have shown the plexus to consist of a veritable network of nerve fibers. The description of the plexus by Latarjet and Bonnet (1913)

pictured these fibers as united into a single nerve trunk, consequently, they gave it the name of "pre-sacral nerve." Numerous studies have been carried out to clarify this question, but in spite of all of the work the facts are still contradictory. Ferey (1926) found a single nerve in only 15 per cent of the 13 dissections which he made. A definite plexus formation was found in the remaining 85 per cent of his dissections. In a series of 80 dissections, Delmas and Laux (1927) found that in 20 per cent of the cadavers the roots were joined together thus forming a true nerve, while in the remaining 80 per cent of the cadavers the nerves were more or less spread out in a plexus formation. Roussel (1926), on the contrary, found a single nerve in 75 per cent of his dissections, a plexiform formation in 20 per cent, and a true plexus with broad meshes in only 5 per cent of the dissections. It has been our experience that the nerves are usually in a plexus formation and rarely combined into a single nerve trunk. In introducing the section of the superior hypogastric plexus into gynecological surgery, Cotte (1925) accepted the description of Latarjet and Bonnet (1913) and consequently named the operation the "section of the presacral nerve." This name has remained prevalent in France so that we shall make use of it frequently throughout this work but only with the understanding that we do not refer to a single nerve trunk but to a variable number of filaments of a great plexus formation.

A few nerve filaments from the superior hypogastric plexus course along the common iliac arteries. The plexus itself continues down over the promontory of the sacrum and at about the level of the first sacral vertebra divides into two distinct nerves called the *inferior hypogastric nerves* (Fig. 3). Delmas and Laux (1927) describe this division as taking place just above the promontory of the sacrum.

The inferior hypogastric nerves. These nerves are usually between 2 and 3 inches in length and course obliquely from above downward in the lateral rectal space. They course along the internal iliac arteries and give off branches which accompany the branches of these arteries, other branches course medially and

terminate in the rectum. The lateral sacral vessels lie slightly medial and posterior to these nerves (Latarjet and Rochet, 1922). The principal ureteral nerves are derived from these inferior hypogastric nerves. After these branches have been given off, the two inferior hypogastric nerves terminate in a mass of nerve fibers and ganglion cells which has been named the *hypogastric ganglion* (Fig. 5) by Lee (1849) and Frankenhaeuser (1867). The actual existence of such a ganglion is debatable. Hovelacque (1927) has defined the "so called ganglion of Frankenhaeuser" as the anterior part of the inferior hypogastric plexus. Dahl (1916) made an histological study of that part of the plexus and he was able to demonstrate occasional masses of ganglion cells within the meshes of the nerve fibers. Lee (1849), Frankenhaeuser (1867), Robinson (1894), Hashimoto (1904), Jung (1905), and Kehrer (1910) have all considered it a true sympathetic ganglion. Latarjet and Rochet (1922) have described the ganglion as a greyish-white felting in the form of a quadrilateral mass the limits and dimensions of which are difficult to fix. The inferior hypogastric nerve is continuous with the medial surface of this mass. The visceral branches to the pelvic organs are derived from the medial surface of the mass while there is a rich anastomosis with the sacral nerves on the lateral surface. The entire mass of ganglion cells and nerve fibers which make up this hypogastric ganglion is situated in the superior pelvic space between the peritoneum and the fascia covering the levator ani muscles. The plexus reforms on the anterior surface of the rectum just posterior to the uterus and vagina and becomes intimately connected with the uterosacral ligaments. Blaisdell (1917) has studied this connection and believes it to be a most important formation. Between the lateral border of the hypogastric plexus and the levator ani muscles are situated the internal iliac vessels. These large vessels are separated from the plexus by the thin genitopelvic aponeurosis. The uterine artery passes over the anterior surface of the plexus. Condomin (1927) has recently revived the old procedure of cutting the uterosacral ligaments for the purpose of relieving pelvic pain that is asso-

ciated with retroversion of the uterus or menstrual irregularities. This procedure was very popular in Europe many years ago but at that time the improvement which followed this operation was thought to be due to some mechanical reason. In the light of the recent anatomical studies it is evident that this operation was in reality a masked sympathectomy (Fig 6).

Afferent branches of the hypogastric ganglion. The afferent branches course to the second and third sacral sympathetic ganglion and carry the impulses through the sacral sympathetic chains. According to the original description by Lee (1849) these branches are usually very thin and not constant as to their course or termination. Eckhard (1862) named these branches the erector nerves and Bishop Harman (1899) called them the pelvic splanchnic nerves. The parasympathetic fibers that come from the sacral roots are the more important. The origin of these fibers varies somewhat according to the author. Cordier (1921) states they arise from the first to fourth sacral roots. Latarjet and Rochet (1922) believe they arise from the second to third sacral while Hovelacque (1927) states they arise from the third to fourth sacral roots. Laur (1927) has demonstrated fibers that connect the hypogastric plexus with the hypogastric ganglion. Hovelacque states that there is constantly a branch which connects the superior hemorrhoidal plexus with the hypogastric ganglion.

Efferent branches of the hypogastric ganglion. The efferent uterine nerves are divided into two groups. The principal group is made up of fibers from the anterior part of the hypogastric ganglion while the accessory group is made up of fibers from the vesical branches. These nerve fibers form a resistant network about the uterosacral ligaments. The majority of the e fibers reach the uterus and are distributed to the lower two thirds of that organ. Latarjet and Rochet (1922) have named one of these branches the lateral nerve of the uterus. This nerve may arise either from the inferior hypogastric nerve of that side anterior to the hypogastric ganglion or directly from the hypogastric ganglion. It passes anterior to the ganglionic mass and posterior to the

uterine artery then courses to the lateral border of the uterus and ascends to the insertion of the round ligament (Fig 5).

Since the efferent nerves to the rectum, ureter and bladder are not concerned with this present problem we shall omit them entirely.

The nerves of the vagina. These nerves come from the anterior part of the hypogastric plexus and from the vesicovaginal branches of that plexus (Latarjet and Rochet) while a few filaments come from the sacral roots. According to Kuntz (1930) nearly all of the more recent investigators have described a relatively simple plexiform arrangement of nerves which include small ganglia and which are situated in the upper and middle part of the vagina.

MICROSCOPIC ANATOMY OF THE NERVES TO THE FEMALE SEX ORGANS

During the past few years considerable investigative work has been carried out to determine the constitution of the peripheral sympathetic nervous system. The work of Cotte and Noel (1927) and of Lenche and Fontane (1929) has emphasized the fact that ganglion cells are present along the course of the intermediary nerve trunks as well as in the meshes of the great plexuses of nerves in the pelvis. It is impossible to separate the individual nerves from these plexuses and masses of ganglion cells. The important fact is that the entire sympathetic innervation of the genital organs as well as the sympathetic innervation of all other viscera is in the form of a vast plexus of nerves the meshes of which are sometimes wide while at other times the fibers are matted together with small masses of ganglion cells cattered along the entire course of the nerves. For this reason one should not consider the peripheral sympathetic nervous system as consisting of separate ganglionic centers that are connected by intermediate nerve fibers which act only as peripheral conductors of nervous impulses.

Intrinsic innervation of the ovary. Among the early investigators Frankenhauser (1867), Waldeyer (1870) and Ellisfischer (1876) described the intrinsic nerves of the ovary as supplying the ovarian follicles as well as the

blood vessels, but Vedeler (1890) was unable to demonstrate fibers which enter the follicles. Other observers, such as Riese (1891) and Von Herff (1892), described nerve fibers in the ovary as penetrating the membrana propria and terminating in the stratum granulosum of the follicular wall. Von Herff (1896) described cells which he regarded as ganglion cells within the ovary, but later he was unable to substantiate that claim. Cromaffin cells have been described in the stroma of the ovaries. Kuntz (1919) made a very careful and complete study of this problem. He found an abundant nerve supply to the blood vessels and fibromuscular tissue in the stroma but no nerve fibers which either penetrated the ovarian follicles or terminated in relation to them. He and his pupils were also unable to demonstrate any nerve supply to the interstitial secretory tissue. Ganglion cells were not observed within the ovary in any of the preparations which they studied. Walter (1782) and Dahl (1916) have demonstrated ganglion cells along the ovarian nerves but never actually within the ovary or fallopian tubes. Lee (1840) described a large ganglion at the level of the tubo-ovarian angle. According to von Koellicker (1894) and Dahl (1916), the great majority of the nerve fibers which supply the ovary and fallopian tube are unmyelinated, but occasional myelinated fibers have been found interposed.

Intrinsic innervation of the fallopian tube The fallopian tube is supplied by both unmyelinated and myelinated fibers derived from the ovarian and uterine plexuses. According to Kuntz (1930), the nerve fiber bundles penetrate the wall of the tube and give rise to branches which are distributed to all layers except possibly the mucous epithelium. A definite plexiform arrangement of these fiber bundles is not apparent. Von Herff (1892) supported the theory that nerve fibers penetrate the mucous epithelium and terminate in relation to the epithelial cells. He also claimed to have observed ganglion cells in the wall of the tube. Dahl (1916) described nerve fibers in all the layers of the fallopian tube except in the mucous epithelium. He observed very fine branching fibers which approach the epithelium very

closely but he could not determine if they actually terminated in relation to the epithelial cells. He showed that the nerve supply is most abundant toward the uterine end of the tube. He did not find a definite plexiform arrangement of the nerve fibers in any part of the tube, nor did he observe ganglion cells in the tube or broad ligament (Kuntz 1930).

Intrinsic innervation of the uterus The nerve fibers in the wall of the uterus are distributed mainly to the uterine musculature. Some of the older investigators maintain that nerve fibers also terminate in relation to the uterine mucosa, but, according to Kuntz, the majority of the data available at present does not support this view. Dahl states that the bundles of nerve fibers run parallel to adjacent bundles of muscle fibers to which they give off branches and these branches terminate in relation to muscle cells. He also states that the nerve supply is quite uniform throughout the uterus except in the region of the fallopian tubes, where it is especially abundant. He was able to trace nerve fibers as far as the mucosa but he never observed nerve fibers actually within the mucous epithelium. Many investigators, notably Remark, La Torré (1907), and Kieffer (1920), have described elements in the wall of the uterus in the human and animal species which they interpreted as ganglion cells, others found no true ganglion cells within the uterine wall (Frankenhaeuser and Dahl). Medowar (1928) states definitely that he could not find intramural ganglion cells in the uterus of the dog. Kuntz feels that in all probability true ganglion cells have been observed in the wall of the uterus in some instances, but that they must be regarded as cells which became displaced from the ganglia in the uterovaginal plexus during the course of development.

PHYSIOLOGY

It has long been the classical teaching that the hypogastric plexus exerts a vasoconstrictor action on the vessels of the internal genital organs while the parasympathetic nerves (nervi erigentes) exert a vasodilatory effect. The sympathetic nerves inhibit the secretion of the genital glands while the parasympathetic nerves stimulate the glands to secretion.

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of motor function of the bladder or rectum, seems to us to be clinical evidence that these genital nerves of the sympathetic nervous system are sensory rather than motor in nature. The experimental studies of Leriche and Stricker (1927) show that the nerves of the superior hypogastric plexus carry afferent impulses. They studied the influence of stimulation of the presacral nerve upon the blood circulation in the dog. One cannula of François Frank was inserted in the central end of the carotid artery and another was inserted in the peripheral end of the internal iliac artery. Excitation of the superior hypogastric plexus (presacral nerve) gave an immediate rise in both the general and peripheral blood pressure. After a short time there was a gradual drop in the pressure in both arteries. The curves of the pressure in the iliac and the carotid arteries showed relatively the same variations. The superior hypogastric plexus was then cut and the peripheral end was stimulated with an electric current. Neither the general nor the peripheral circulation was influenced by this stimulation. However, when the central end of the cut nerve trunk was stimulated in a similar manner the general and the peripheral circulation was modified to the same extent as when the intact nerve trunk was stimulated. The stimulation of the intact nerve or the central end after the nerve had been cut caused the animal to awaken from the deep general anaesthesia and groan as though it was suffering from intense pain. Stimulation of the peripheral end of the cut nerve trunk caused no action of that kind.

Latarjet and Rochet (1922) have expressed the theory that the severe pain associated with pathological processes in the region of the uterosacral ligaments and in the retro-cervical region is due largely to stimulation of the hypogastric ganglion.

AFFERENT NEURONS OF THE SYMPATHETIC NERVOUS SYSTEM

The existence of sympathetic neurons which are incorporated in conducting pathways through which afferent impulses are conveyed into the central nervous system is still a matter of great dispute, yet considerable anatomical

and physiological data are available which show clearly that the myenteric and submucous plexuses contain reflex mechanisms and are capable of carrying out co-ordinated reflex activities independent of the central nervous system. In 1874, Sokolowin demonstrated that stimulation of the central end of a severed hypogastric nerve caused a symmetrical contraction of the urinary bladder even after the inferior mesenteric ganglion had been severed from all medullary centers. These experimental results which show the rôle played by the reflex centers in the inferior mesenteric ganglion were confirmed by Courtade and Guyon (1895) and Laignel-Lavastine (1903). All of these results add further proof to the work of François Frank in regard to the sympathetic reflexes. Langley and Anderson (1893) obtained the same results as Sokolowin, but, since the observed reaction persisted after complete disarticulation of the synapses by nicotization of the ganglion they concluded that the reaction was due to an "axon reflex." Inasmuch as they thought the reflexes depended upon afferent conduction through preganglionic fibers, they gave them the complete name "pre-ganglionic axon reflexes." According to this theory there are no true sympathetic reflexes but efferent fibers have the ability of conducting impulses in the opposite direction (antidromic manner), consequently, no need exists for a real reflex that requires the integrity of the synapses in the sympathetic ganglia. We feel that fibers that have the ability of conducting impulses toward the central nervous system should be called afferent fibers rather than efferent fibers with the ability of conducting nervous impulses in an antidromic manner. In the light of the recent histological studies of Leriche and Fontaine showing that ganglion cells are present along the nerve trunks and scattered throughout the various sympathetic nervous plexuses (Fig 7), it is quite probable that all the synapses were not disarticulated by the local application of nicotine or even by the intravenous injection of that drug. The other factor, namely, the absolute specificity of nicotine for all the synapses of the sympathetic ganglia is a question that we are not qualified to discuss.

The exact control of the motility of the uterus is still unknown. Langley and Anderson (1893) have shown that the center of uterine contractions for the rabbit is situated between the tenth dorsal and the second lumbar segment of the spinal cord. Dahl considers the sympathetic fibers as the excitors while the parasympathetic fibers are the inhibitors of uterine contractions. Roehrig (1879), Kehrner (1900) and Hofmann (1926) consider the sympathetic fibers as the motor nerves to the circular muscle fibers and the parasympathetic fibers as the motor nerves to the longitudinal muscle fibers of the uterus. Bach and Holmann (1926) believe that fibers from the hypogastric plexus control the opening of the cervix of the uterus and impulses through the nervi erigentes cause the cervix to close. Finally Berger (1923) and Dahl (1924) have expressed the theory that the sympathetic nerves take on the function of excitors to the uterus during pregnancy. Thus we see that our ideas concerning the influence of the sympathetic nerves on the function of the internal genital organs in the female are still vague and incomplete.

During the past year we have been especially interested in studying the influence of the pelvic sympathetic nerves upon menstruation and parturition, the two normal functions of the internal genital organs of the female.

The pelvic sympathetic nerves in relation to menstruation. The section of the superior hypogastric plexus does not alter the normal menstrual cycle. However if the last regular menstrual period ended more than 4 or 5 days prior to the section of the superior hypogastric plexus there will appear an atypical or supplementary menstrual period on about the second postoperative day. We are inclined to believe that this is the result of an intense uterine congestion which follows the pelvic sympathectomy and it should not be considered as a true menstrual period. The subsequent menstrual period appears about 8 days after the pre-operative period and not in relation to the supplementary postoperative hemorrhagic discharge from the uterus.

From the experimental standpoint the work of Bouin and Courner (1909) and of

Buchheim and Zaleski (1930) throws some interesting light on this question. These investigators transplanted fragments of one horn of the uterus to the subcutaneous tissue of the ear of the same adult rabbit. The grafts took very well. Under the influence of an unfertile coitus which caused the follicular rupture and the formation of the corpus luteum the mucosa and muscular layers of the grafted fragments of uterus underwent histological changes that were identical with the changes that took place in the horn of the uterus that remained in place in the abdomen. When the grafts were at rest only a slight hyperemia and edema of the chorion were produced by cervical sympathectomy. If however the cervical sympathectomy was done several days before the follicular rupture and the subsequent production of the corpus luteum the structural changes were found to be much more marked on the side on which the cervical sympathectomy was performed. These studies show that the lutein hormone exercises its action outside of all nervous influence but that the effect of the hormones can be augmented by increasing the vascularity of the part.

The pelvic sympathetic nerves in relation to childbirth. The classical experiments of von Goltz and the clinical observations of Mueller Brachet and Gertsmann have demonstrated clearly that neither the section nor the complete destruction of the sacral part of the spinal cord will prevent childbirth but only make it necessary to apply forceps to the head of the child low down in the birth canal because of the paralysis of the perineal and vulvar muscles. Rein (1882) has reported the spontaneous birth of young in rabbits following the section of all the extrinsic nerves to the uterus. There are also many cases on record in which normal parturition took place in patients who had previously been subjected to a resection of the superior hypogastric plexus for the relief of some painful condition in the pelvis.

The fact that section of the extrinsic genital nerves does not alter the normal menstrual cycle does not interfere with spontaneous parturition does not produce glandular atrophy, chronic pelvic congestion or any disturbances

Group B The great majority of cases naturally fall into this group, for it is comparatively rare to find true functional dysmenorrhœa without the slightest demonstrable pathological lesion or anatomical abnormality of the internal genital organs. It is, of course, very difficult to determine the exact rôle played by a mobile retroversion of the uterus or slight sclerocystic degeneration of the ovaries in the production of severe pelvic pain. Since the pelvic pain frequently persists after the retroversion of the uterus has been corrected or after the sclerocystic ovary has been removed, one can be quite certain that these minor lesions were not responsible for all of the pelvic pain. Then, too, one frequently finds sclerocystic degeneration of the ovaries or a mobile retroversion of the uterus in women who have never had dysmenorrhœa or pelvic pain. The recent work of Lhermitte and Dupont and of Roux suggests that there is a definite lesion of the sympathetic nerves in the ovaries to account for the pelvic pain in certain cases of sclerocystic degeneration of those organs. They have been able to demonstrate perfasicular and intrafasicular sclerosis of the sympathetic nerves with frequent neuroma formation (Fig 8). These lesions of the nerves were so marked in many of the cases that these authors have suggested that sclerocystic degeneration of the ovaries is the result of such pathological processes in the sympathetic nerves. At present it is impossible to say if that is true or not but from the recent work of Professor Lenche we have learned that neuromata of the sympathetic nerves as well as of the spinal nerves have the ability of producing marked vasomotor disturbances that give rise to crises of severe pain. For this reason we are inclined to attribute more importance to the neuromata in the ovaries especially in relation to the symptomology associated with sclerocystic degeneration of the ovaries. Undoubtedly, some of the good influence of pelvic sympathectomy in such conditions can be explained on the basis of modification of the vascularization and secretion of the internal genital organs as has recently been shown experimentally by Chianello (1930), however, we believe that the interruption of the

ascending pathways of many pathological reflexes from these organs is equally important.

In all cases of mobile retroversion of the uterus or slight sclerocystic degeneration of the ovaries, proper medical and non-operative gynecological treatment should always be given a fair trial. If, after a reasonable length of time, there is no improvement in the subjective symptoms the question of operative interference should be considered. It is well known that the palliative operations, such as, partial resection of an ovary or an unilateral oophorectomy, frequently give no relief from the pain in the pelvis in cases of sclerocystic degeneration of the ovaries. The patient is usually subjected to a second or third palliative operation without lasting benefit. Finally, a total hysterectomy is performed when the patient is still in her early thirties. All of this surgery has been done as treatment of a symptom complex which, originally at least, was only the result of some functional derangement of the pelvic sympathetic nerves. This type of patient is usually completely relieved of the pelvic pain by simple section of the superior hypogastric plexus without the sacrifice of any of the internal genital organs and without influencing the subsequent marriage and ability of bearing children of that young woman.

The real value of the pelvic sympathectomy has been established by the exhaustive work of Cotte and Michon. In cases in which there are definite anatomical lesions present which might account for part of the pelvic pain, we do not advise the section of the superior hypogastric plexus as the sole therapeutic procedure. We believe that at the time of the laparotomy the retroverted uterus should be suspended in the normal position and the cystic portion of the ovary removed, but the pelvic sympathectomy should be the most important part of the operation. The objection that one cannot determine exactly which of the procedures actually relieved the pelvic pain will always be brought up. Cotte has worked out his statistics very carefully, and in over 200 cases in which pelvic sympathectomy was combined with the other procedures his results were far superior to those

The experimental studies of Sokowin Gianuzzi Latarjet and Rochet demonstrate clearly that the hypogastric plexuses also contain efferent fibers to the urinary bladder. Partial paralysis of the bladder with marked urinary retention follows the removal of one superior hypogastric ganglion while the removal of both of these ganglia gives complete paralysis of the bladder muscles with subsequent marked distention and an inability to micturate spontaneously. However after the simple removal of the superior hypogastric plexus (presacral nerve) disturbances of micturition or transient retention of urine must be considered as extremely rare. Such cases of disturbances of the function of the bladder have all been transient and of no serious consequence. Brocq reported one case in which the partial retention of urine lasted for 9 days after the operation. Recently on the other hand Learmonth and Braasch (1930) employed the resection of the presacral nerve in the treatment of a cord bladder with gratifying results.

One of our patients (Case 18) returned to the clinic $2\frac{1}{2}$ months after the resection of the superior hypogastric plexus because of lower abdominal pains due to a marked distention of the bladder. There was no evidence of urinary infection. After being catheterized regularly for several days she regained the function and she has had no further urinary disturbances since that time. In cases of acute retention of urine which immediately follow an operation in the pelvis the question of trauma to the bladder during the operation must always be considered.

We feel that the hypogastric plexuses carry the important pathways of sensation from the internal genital organs to the medullary centers and that the section of the superior hypogastric plexus (presacral nerve) above the hypogastric ganglion is a safe simple and efficacious way of interrupting these pathways in the treatment of the functional type of dysmenorrhœa as well as a method of relieving other forms of severe pelvic pain.

SURGERY OF THE PELVIC SYMPATHETIC NERVES

I Indications for the operations Since the pelvic sympathetic nerves are essentially

afferent in nature they regulate the functional co-ordination of the internal genital organs and by reflex action control their vascularity, the secretion of their mucous membranes and their entire visceral sensibility. Consequently all operations upon this system of nerves are primarily directed toward the interruption of the ascending pathways of pathological reflexes and to sever the afferent fibers from the internal genital organs with the resultant abolition of the pelvic pain. The cases in which pelvic sympathectomy is indicated can therefore be divided into three main groups.

Group A Those cases in which no organic lesion of the genital organs can be found to account for the pelvic pain i.e. functional dysmenorrhœa.

Group B Those cases with slight pathological processes in the pelvis which do not react favorably to ordinary gynecological treatment i.e. sclerocystic degeneration of the ovaries, persistent pelvic pain following some previous operation.

Group C Those cases in which the pathological lesion is known but which has been found to be too extensive for surgical removal i.e. inoperable neoplasms in the pelvis giving rise to severe pain.

Group A The functional type of dysmenorrhœa characterized by severe crises of pain immediately preceding or during the menstrual period that resist the ordinary gynecological therapeutics have been found to react most favorably to the operations upon the pelvic sympathetic nerves. Cotte (1929) has given the name *plexalgia* to that type of functional dysmenorrhœa in which the pain is primarily localized to the uterus but which radiates to the anus, coccyx and urinary bladder, the regions corresponding to the distribution of fibers from the superior hypogastric plexus. The type in which the pain radiates to the lumbar and obturator regions is usually due to disturbances of the ovarian sympathetic plexus. The group of functional dysmenorrhœa which reacts favorably to pelvic sympathectomy also includes those cases of genital hyperexcitability which have crises of dysmenorrhœa and congestion of the pelvic organs accompanied by severe pain.

plexalgia In cases of trophic disturbances of the external genital organs, especially kraurosis vulvæ, only the peri-arterial sympathectomy of the internal iliac artery is indicated, since the nerve fibers to the vulva do not pass through the superior hypogastric plexus

D The section or removal of the lower part of the lumbar sympathetic chain on one or both sides should be used as an adjunct to other pelvic sympathectomies In cases of inoperable carcinoma or sarcoma in the pelvis, in which the neoplasm has invaded into all the pelvic organs, a very complete pelvic sympathectomy must be done in order to relieve the patient of all the pain We believe that in all such cases the sectioning of the superior hypogastric plexus and the removal of the pre-aortic plexus as high as the origin of the inferior mesenteric artery should be done in addition to the resection of the lower part of both lumbar sympathetic chains Lumbar ramisection or extirpation of the lumbar sympathetic ganglia have been shown by Leriche (1924), Hunter (1924), Royle (1924), Adson and Brown (1925), Wade (1927), and many others to be of great benefit in other diseases but those indications cannot be discussed at this time

III *General review of results obtained*
Prior to 1925, all cases of functional dysmenorrhœa or hypogastric plexalgia that did not respond to the usual gynecological treatment were treated by perarterial sympathectomy of the internal iliac or common iliac arteries The results published by Leriche (1925), Hallopeau (1922), Cotte (1925), Michon (1926), and Bittmann (1925) show that this operation gave complete and lasting relief in the great majority of the cases After 1925, however, the simpler method of the resection of the superior hypogastric plexus (presacral nerve), which was introduced by Cotte, became the common operation for this type of pelvic pain In 1927, Cotte reported 90 patients in which the section of the presacral nerve was performed for functional dysmenorrhœa and hypogastric plexalgia The great majority of these patients were completely relieved of the pelvic pain In 1929, he reported 200 patients in which very satisfactory results were likewise obtained

Michon reported a series of 22 patients in which pelvic sympathectomy (section of the presacral nerve, peri-arterial sympathectomy of the internal iliac artery or sacral ramisection) was followed by complete relief of all subjective symptoms In 1926 Ferey published his first 10 cases, and in 1929 he added 40 new cases Of these 50 cases he states that 47 per cent of them were completely relieved of all pelvic pain, 45 per cent were reported as greatly improved and only 8 per cent were reported as having received no benefit from the pelvic sympathectomy Hamant (1926) reported 18 cases in which pelvic sympathectomy gave excellent therapeutic results Walther (1929) basing his opinion on 14 cases states that section of the presacral nerve is also indicated in cases of chronic painful salpingitis and chronic metritis when thorough medical and gynecological treatment fail to relieve the pelvic pain He states that the sympathectomy gives better results than the more radical gynecological operations of salpingectomy or hysterectomy He also believes that the sympathectomy should be done in connection with all conservative operations in the pelvis, such as fixation of the uterus or resection of one fallopian tube when pelvic pain is an outstanding pre-operative symptom Cueille (1929) reported 12 patients who were completely relieved of the pelvic pain after the resection of the superior hypogastric plexus These results have been confirmed by the reports of Tisserand (1925), Bonnet (1927), Costantini and Schebat (1928) and many others

Pelvic sympathectomy has also been widely practiced outside of France In Roumania, Gomoiu (1920), Georgesco (1926) and Jianu (1928) have reported great success in a large series of cases In Spain Soler-Julia (1928) reported excellent results with this form of therapy Pereira (1929) in Portugal, Fabião (1928) in Brazil and Rophille (1926) in Argentine have also reported great success in treating the rebellious types of dysmenorrhœa and hypogastric plexalgia by sectioning the presacral nerve In Switzerland, Aubert (1929) reported 14 cases with very satisfactory results from the pelvic sympathectomy In Italy, Pieri (1926), Micheli (1927), Tirelli

which he obtained in an equally large series of cases in which only the ordinary gynecological procedures were done. The reports of Michon as well as our own experience show that in properly selected case of functional dysmenorrhœa complete and lasting relief follows the simple section of the superior hypogastric plexus.

Group C. The severe pain associated with inoperable neoplasms in the pelvis or more rarely due to the sclerosis in the pelvis following intensive radiation by radium or deep X-ray therapy should be treated surgically in spite of the fact that there is no hope for an operative cure of the neoplasm. Numerous procedures have been proposed for the relief of pain under such circumstances but most of them have failed to give uniformly satisfactory results. If the surgeon performs an extensive sympathectomy within the abdominal cavity he has an opportunity of verifying the pathological lesion, determine its extent and occasionally find the cause for the extreme pain. Professor Lenche was the first to show that the mechanism of the production of pain was not the same in all cases. In one case he simply removed a pyosalpinx which had developed as a result of the intensive deep X-ray therapy and which had become adherent to the common iliac artery. The pain disappeared completely after the removal of this inflammatory mass from the artery. Another patient showed typical root radiation of the pain consequently she was completely relieved of the pain after section of the corresponding posterior root. In all cases in which there is no metastasis to the vertebrae and no typical root radiation of the pain we believe that it is advisable to verify the extent of the neoplasm and if possible determine the cause for the severe pain and then perform the complete sympathectomy. Ferey (1977) has suggested the removal of the superior hypogastric plexus in every case in which a hysterectomy is performed for carcinoma of the uterus as a prophylaxis against the pain in case there is a recurrence of the carcinoma. At present it is difficult to say if such a suggestion has any real therapeutic value.

II Types of operations employed. There are four main types of sympathectomies that

may be employed in the treatment of the various painful disturbances in the female pelvis. They are as follows:

A Section of the superior hypogastric plexus (presacral nerve)

B Section of the ovarian nerve

C Periaxillary sympathectomy of the internal iliac artery

D Section or removal of the lower part of the lumbar sympathetic chain of one or both sides

A The section of the superior hypogastric plexus may be performed anywhere along its course from the inferior mesenteric ganglion to the point just below the promontory of the sacrum where it joins the inferior hypogastric plexus (Fig 3). The plexus is easily accessible at the level of the bifurcation of the aorta where it is situated just beneath the peritoneum. It is at this level that one resects a segment of the plexus about 1 inch long in performing the superior hypogastric sympathectomy (Fig 4).

B The denervation of the ovaries according to the method of Lhermitte and Dupont (1926) consists of the isolation and resection of the nerves in the utero-ovarian ligaments. The operation is quite difficult to perform and one can never be certain that all of the nerve fibers have been severed. From the clinical standpoint it is sometimes impossible to differentiate between the pelvic pain due to disturbances in the ovaries and that due to disturbances in the superior hypogastric plexus. We feel that section of the superior hypogastric plexus should be the operation of choice for the relief of pelvic neuralgias.

C The periaxillary sympathectomy of the internal iliac artery was the first operation upon the pelvic sympathetic nerves which gave complete and lasting relief from the pain of functional dysmenorrhœa or hypogastric neuralgia. Professor Lenche has reported several cases that have had complete relief for over 6 years. The section of the superior hypogastric plexus (presacral nerve) is originally proposed by Cotte (1915) proved to be much simpler from the technical standpoint and the final results were just as good therefore the former operation is no longer used for the relief of the pelvic pain of hypogastric

normal position. The immediate postoperative course was uneventful. On the second postoperative day a moderate amount of bloody discharge from the vagina was noticed. This supplementary menstrual period was without pain or discomfort. The next regular menstrual period appeared on the scheduled day and was not accompanied by the usual pain. The patient left the city a few weeks later so we have been unable to obtain any further follow-up data concerning the ultimate result of the operation.

CASE 4. The patient was a young, unmarried woman, aged 24 years, who was referred to the hospital on March 20, 1927, with a diagnosis of chronic appendicitis. On careful questioning of the patient it was found that the abdominal pain was formerly present only during her menstrual periods but that during the past 5 weeks the pains have been lancinating in character and radiate to the lumbar region and to the right side of the abdomen. Her menses began when she was about 14 years of age and remained regular and only slightly painful until she was about 19 years of age. Since that time the periods have become increasingly more painful and more profuse. The pains have been particularly violent on the second day of the menstrual period. Physical examination of the abdomen showed moderate tenderness over McBurney's point but no muscle spasm. Pelvic examination revealed tenderness in the right side of the cul-de-sac. The uterus was in second degree retroversion. Laparotomy was performed on April 2, 1927. The uterus was found to be in retroversion but the adnexa were free. The right ovary showed marked cystic degeneration. The superior hypogastric plexus was isolated, and a portion about 1 inch long was resected. The uterus was suspended in the normal position. The appendix, which appeared normal, was removed in the routine manner. On the first postoperative day the temperature of the patient rose to 39 degrees C. The patient became very restless and the pulse became rapid and thready in character. The abdomen remained soft and the patient did not vomit. The lungs were normal by physical examination. The heart was not enlarged and there were no murmurs. The rate was very rapid but regular. The patient died on the second postoperative day. Autopsy revealed a marked oedema of the brain. The abdominal, pelvic, and thoracic viscera were normal.

CASE 5. The patient was a young unmarried woman aged 20 years, who was referred to the hospital because of severe and almost constant pains in the lower part of her abdomen. In December, 1926, she was operated upon because of nephroptosis, and a transperitoneal nephrectomy was performed. A few months after this operation, the patient began to have severe sharp pains in the lower part of the abdomen and in the pelvis. The pains have gradually increased in severity, and all palliative methods have failed to relieve the intense suffering of the patient. The radiation of the pains to the lower part of the lumbar region suggested that relief might be ob-

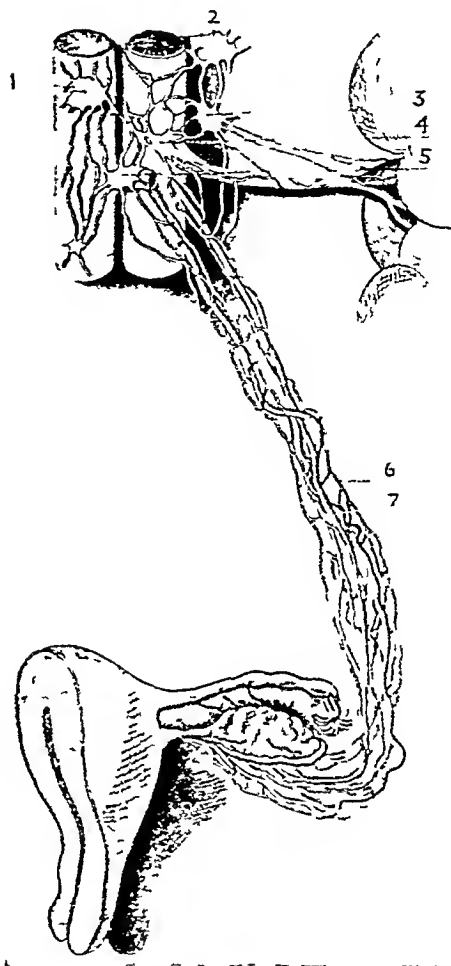


Fig. 1. The innervation of the ovary. 1, Superior mesenteric ganglion, 2, celiac plexus, 3, first renal ganglion, 4, second renal ganglion, 5, spermatic ganglion, 6, spermatic plexus, 7, ovarian plexus. (After Dahl.)

tained by resection of the superior hypogastric plexus. Laparotomy was performed on March 24, 1927. After freeing numerous dense adhesions the superior hypogastric plexus was isolated and a portion about 1 inch long was resected in the usual manner. The postoperative course was uneventful. The patient was completely relieved of the severe sharp pains in the pelvis but still had occasional attacks of dull pain in the lower part of the abdomen. At the time of discharge from the hospital, the patient was practically free from the former pelvic pain and she was quite comfortable and active throughout the entire day. The patient failed to return for further follow-up examination.

(1928) Paolucci (1928) and Spirito (1928) have applied the pelvic sympathectomy in a large series of cases and they all have reported very favorable results. In 1929 de Grisogno reported a series of 35 cases in which resection of the presacral nerve was done for the relief of severe pelvic pain. An excellent therapeutic result was obtained in all cases. In Poland Dziembowski (1930) was the first to apply this method in the treatment of rebellious types of dysmenorrhœa. Ekkert Petersen (1930) reported 9 cases in which resection of the presacral nerve gave complete relief of all pelvic pain.

In the clinic of Professor Leriche during the period from January 1, 1925 to August 15, 1930 the operation of resection of the superior hypogastric plexus (presacral nerve) was performed on 22 young women suffering from some form of severe pelvic pain. In one case (Case 18) only the resection of the superior hypogastric plexus was done. In all the other cases the associated anatomical derangement or slight pathological lesions were corrected at the same operation. The following abstracts of case records will serve to show the results which we have obtained.

EFFECTS OF THE REMOVAL OF THE SUPERIOR HYPOGASTRIC PLEXUS IN PATIENTS WITH FUNCTIONAL DYSMENORRHOEA AND HYPOGASTRIC PLEXALGIA

CASE 1. The patient was an unmarried woman aged 33 years who was confined to the hospital because of chronic dysmenorrhœa. She complained of pain in the right lower quadrant of the abdomen. Nausea or vomiting was associated with the pain in the abdomen. Her menstrual periods began when she was 4 years of age. They have always been regular but in the last 10 years the periods have been irregular. The periods last 3 to 5 days and are usually very painful. There is moderate flow. No improvement was obtained with pain after treatment with a gynecological catheter. Pelvic examination revealed the uterus to be slightly retroverted. Laparotomy was performed on July 6, 1927. The uterus was found to be normal and the ovaries were healthy. The fallopian tubes were normal. The uterus was found to be normal. The appendages were normal. The uterus was found to be normal.

after the operation the regular menstrual period appeared but was entirely without pain. The condition of the reproductive system was normal. The patient was discharged on July 13, 1927. The patient was still alive and well on July 13, 1931. The patient was still alive and well on July 13, 1931.

CASE 2. The patient was a married woman aged 30 years who was sent to the hospital because of pelvic pain. The lower part of the abdomen and the right side of the lower abdomen were painful. The menstrual periods began when she was 13 years of age and were always regular and painless until a few years ago. Because of the fact that the menstrual periods became extremely painful she sought the advice of a family physician. After a month of treatment she was told that a laparotomy was necessary. This patient was sent to the hospital for the removal of the ovarian cysts. The patient was relieved by this operation. After a month of treatment she was sent to the hospital for the removal of the ovarian cysts. The patient was relieved by this operation. After a month of treatment she was sent to the hospital for the removal of the ovarian cysts. The patient was relieved by this operation.

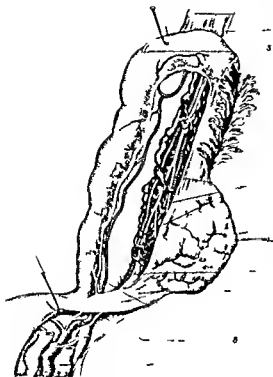
CASE 3. The patient was a married woman aged 35 years who was sent to the hospital because of pelvic pain. The patient was associated with the menstrual period. Her menstrual periods began when she was 14 years of age and were always slightly irregular. The menstrual periods began when she was 14 years of age and were always slightly irregular. The menstrual periods began when she was 14 years of age and were always slightly irregular. The menstrual periods began when she was 14 years of age and were always slightly irregular. The menstrual periods began when she was 14 years of age and were always slightly irregular.



Fig 3 The hypogastric plexus in the female 1, Ureter, 2, ovarian artery, 3, external iliac artery, 4, obturator nerve, 5, branches from the sacral sympathetic chain, 6, superior gluteal artery, 7, superior gluteal nerve, 8, anterior branch of second sacral nerve, 9, sympathetic fibers to inferior hypogastric plexus, 10, secondary branches of hypogastric plexus, 11, nerve to the levator ani muscle, 12, pudic nerve, 13, uterine artery, 14, long vaginal artery, 15, intermesenteric nerves of right side, 16, superior hypogastric plexus, 17, fibers from fifth lumbar sympathetic ganglion to superior hypogastric plexus, 18, nerve fiber of superior hypogastric plexus, 19, left inferior hypogastric plexus, 20, right inferior hypogastric plexus, 21, superior hemorrhoidal plexus, 22, ovary, 23, right umbilical artery, 24, vesicovaginal artery, 25, per ureteral nerves (After Hovelacque)

to the hospital (July 5, 1928) General physical examination was normal Pelvic examination revealed a slight retroversion of the uterus No abnormal masses were palpable in the adnexal regions Laparotomy (Pfannenstiel incision) was performed on July 13, 1928 The uterus was found to be in

acute retroflexion The left fallopian tube and ovary were adherent posteriorly but they were freed without difficulty The left ovary contained a dermoid cyst about the size of a walnut The right ovary showed marked cystic degeneration Partial resection of the right ovary was done, and the left



F D t l d t m y f t h f t h y
 S p y l k m t f t h y n n
 j t l t b l b h g p l s f i l m t t
 l t r a l b d f t r u o t o h g m t 7
 t b l b h f m l t l t n p l s t
 b h f m u p l v a p l t e l t t r y
 (Wt II l a q)

CASE 6 The p t e t w a m d m g d
 35 y a r w h o t d t h h p t l b e c a s o l s
 p t e d w t h h e m e s t a l p o d H
 m e n s e s h e a l b l i g h t l y e g u l r d
 m d a t l y p a f l d g t h p s t f e w y e a r t h
 p n h s h e c m e p g e s v e l y w o r s d t h y
 h h a b u c o m p l l d g t b d d g t h f i t
 p t f e h m t l p d F l s m d e t e
 m u n t p h e t e e t h m n s t r l
 p d S h h d b e e t e t e d m e d c l l y l
 m t h s w t h t b e f t e l m t w
 n o m l L a p t m y w p f m d A p l
 o g F h t e r u s w f d t h l i g h t d g e e
 o f r t T h e l f t y h d e t e
 y t c d g e r t a d t t h e e f e m d
 T h a w v e r v t t s d l g d
 T h s p h y p o g t p l e u s s o l t d a d
 p o t n h t c h l g s t d T h e
 u t r u s s p d d t h n o m l p o s t T h e
 p a t e t m d e t f l c e y T h e s p
 p l m e t m t l p e o d h c h p p d
 d y s f t t h e p e t i w a w t h o u t p d

m l t A t t h e t i m e o f d s c h g f o m t h h p t l
 t h p a t e t w e t e l y f e e f m h r f o m s y m p
 t m s S h f a l d t o e t u f f u r t h e f o l l w p
 e a m t i c e q u a l l y e h a e n d a t
 e i n g t h e f i l r l t l t h e o p t i t h c a s e

CASE 7 The p t n t w m a d m a g e d
 5 y r w h w a e f e d t o t h h o p t a l b s e
 f m a k e d d y s m o h o r a h e r m n s e b e g h
 h w a s 4 y e a f a g e d e e l y e g u l
 S h h s a l w v s h d s e c r a m p l k p s i t h
 l e r p t o l t h e a b d m n m m e d t l y b i e t h
 t o l t h m t u l p d d g r t d l f
 c h g p n t h l e l m b r g t h o g h t
 t h e n t m e n s t l p d A b t 2 m t h s p
 t o b e t c e t t h h p t l h d e v e l o p d

e p o f h r p t b b n g t e t h g h t
 l e q u a d t o f t h e a b d m e T h p d a d
 t t h c r o l c e g o n a d e g t l y e g g t d
 b y a l k g N n s e v m t g s o c t e d
 w t h t b s p a A d a g s o f h c p p e d t
 s m a d b y h t t e d g p h y s c n A t t h e t m
 f t y s t t h h o p t l n J a u a y 9 8 t h
 e t p h y c a l m n a t m l C h l e
 y t g a m h d a m l f u c t n g g a l l b l d
 d T h g s t t e s t i a l X y t d e

t l l y n m l V a g l m t i o n r e l d t h
 t u s t b e m t h p o s t i o r p o t b t t c o u l d
 l y b e b g h t u p i n t h m l p s t l a
 t h g h t d e o f t h l d e s c s l i g h t l y e n l g d
 y c o u l d a u l y b e p a l p t d S l i g h t p s r e
 t h o a v s e d t b p t e t g e t p L p a r o t
 o m y w s p e f o m d o J u a r y 9 8 A s m a l l
 P o a j s t w a f d c h d B t h

h e d m k d y t c d g e e t n T h
 g h t o v a y a l i g h t l y a d h e r t t h e c u l d s
 T h s p h y p g t c p l w o l a t e d
 p o t a b u t h l g w s r s e t e d t h e l
 m e r N p c a l l y t h p p e d p p e d
 n m a l b t t w s m d a t i n e p d
 T h s p p l m e n t r y m t l p e d a p p d
 t h d y i l l g t h e p t T h e t g u l

m t l p d p p e a d o n J u a y 7 t s
 d y l t t h e l s t o m l p e d b t e t u r l y t h
 t p o d c m f t D g t h p a s t j a
 t h p t t h b s e e s e l t m s d h
 m t l p d h v e c t u d t b r g u l r d
 p n l T h e f l w s s l i g h t l y g e a t e t h t a
 b e f e t h e p e r a t b t p t t h e p d l t
 n l y 3 d s t e d f t h p o p a t v e d r t o f
 6 t 7 d a y S h h g d l i g h t l y n e w g h t S h
 b a s h d j d t b w a n d h b o w l
 m m t h e m d r e g l

CASE 8 The p t e t w m d w m a g d
 39 y e w h w s e f r r d t o t h e h p t l b u s e
 o l d y s m e h o r a n b l i t y b c m e p r g
 t l t r 6 y e a r s o f m r d i l l e m e e
 u s l l y r g u l r b t o c c a o l l y t h w s
 t e r v l o f a b o u t 6 e k b e t w t h p r d s S h e
 h d b d m o d e r t l y s v r p s t h l o l m b
 g a d n t h l w e r p r t f t h b d m n d g
 t h e f i t p t o f c h m s t l p r d L t
 m t l p e d d d i w e e k p t h e a d m s s

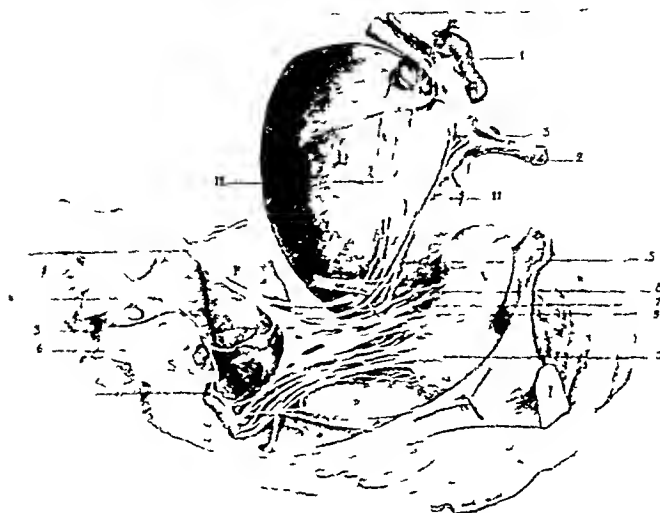


Fig 5 The hypogastric ganglion and its branches in the female (Dissection made on a woman who died 8 days after delivery) 1, Fallopian tube, 2, round ligament, 3, hypogastric ganglion, 4, hypogastric nerve, 5, sacral anastomoses, 6, nerves to rectum, 7, external uterine nerve, 8, peri uterine plexus, 9, nerves to urinary bladder, 10, nerves to vagina, 11, lateral nerve of uterus, 12, tubular branches from nerves in broad ligament, 13, plexus of nerves at base of round ligament, 14, lumbar sympathetic chain, 15, uterine artery, U, uterus, V, vagina, B, urinary bladder, RR', rectum, P, pubis, I, ischium, S, sacrum (After Latarjet and Rochet)

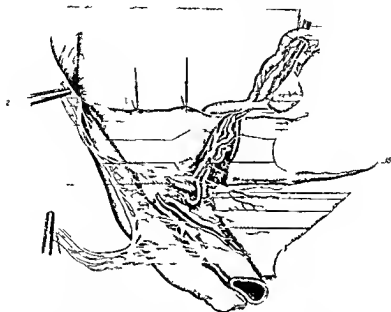
vomits frequently and is markedly constipated. Leucorrhœa is profuse and there is occasional incontinence of urine when she is in the standing position. Vaginal examination revealed the uterus to be slightly enlarged and the cervix bilaterally lacerated. There was some tenderness in both adnexal regions. Laparotomy (Pfannenstiel incision) was performed on November 18, 1928. The uterus and adnexa were free. There was a small subserous fibroma on the postero-inferior surface of the uterus. Both ovaries showed moderate cystic degeneration. The small fibroma and the vermiform appendix were removed. The presacral nerve was sectioned. The supplementary menstrual flow appeared on the second postoperative day but it was painless. At the time of discharge from the hospital the patient was entirely free from the pain in the lower part of the abdomen and pelvis. She did not return for further follow-up examinations.

CASE 11 This patient was an unmarried woman aged 19 years, who entered the hospital because of severe lower abdominal pain associated with her menstrual periods. Her menses began when she was 12 years of age and were regular and painless until she was about 15 years of age. Since that time she has had an increasing amount of pain with each menstrual period, so during the few months prior to her admission to the hospital it was necessary for her to go to bed during the first 3 days of each

period. The periods last from 10 to 12 days and are most painful on the second and third days. The general physical examination was negative. Vaginal examination showed the adnexa to be free and the uterus in a slight degree of retroversion. Laparotomy was done on November 20, 1928. Both ovaries showed moderate cystic degeneration. The uterus was suspended in the normal position. The appendix was removed. The presacral nerve was sectioned in the usual manner. On the second postoperative day, the supplementary period appeared without the slightest pain or discomfort. She was discharged



Fig 6 Sagittal section through the uterosacral ligament showing the nerve fibers between the two peritoneal surfaces (After Latarjet and Rochet)



F 4 Th nf hypoga t pl ru th f mal S peri hxm h d l
 pl xu t m b t th p h m h d l pl ru d f hypo
 g t pl 3 p t segm t f f hypog t pl 4 b h t t m
 s pot l 3 f b d ligam t 6 bra h to t ru 7 t 8 sec d ry
 fra h f mp d d l pl ru 9 pl ru f l l b t b t m l t b
 l b h f t p hes f m t ry 3 t b l b b f m t
 pl f s t b hes f m pl ru 6 t n l y f b d l ga
 m t 17 fil m t t p t m 8 l t r a l t n pl ru 0 p t l
 f th r f l l g t t ry t n t ry l g g l t ry
 (Vt H l q)

v w mo d F l g erv t k f th
 s peri hyp g t ple us w t d f d
 t f b t ch Th te us w s s p d d
 th normal p t Th pot p at e
 m l O the f t p t p t d y a m d
 e te s ros gu d h ge f m th g a
 a n t d Th s n p as o c a t t b t t
 s ppl me t y pe d At th t m f d sch ge
 f m th h o p t a l b t 3 k f t h o p r a t o n
 the p t e w e t e l y f e f m p o d m f t
 A sh o t t m l t e sh t n d t h h m
 P l d d w h a b b l t b t v
 f th r f l l p d t g th l t f the
 p t

CAS 9 Th p t e t w s n u m r d m
 aged 6 y a s h f d t th h p t l
 b a s e f v s d m h e r H m
 beg wh h was 16 f g d h l w v
 b n e 3 p f l p f d gul Th v
 h d b n p p a r g y t 3 w k d th
 fl u l l t d f g l s T 3 d
 b f o the set f the p d th p t w l l
 h e l the d h e f l e l b t t k f
 m t g v a g l e m t n r l d th g

b ormal L p t my s p e f m d n Sept m
 b 8 0 8 The te s was fr ly m bl l
 good p to Th pp d p p e d n m l
 hut t w m d t p o e d The
 s p hyp g t c p l e s s l t d d
 t d th u l m e O the d v fol l g
 the per t th up pl m t a r y p e d a p p red
 hut t a n t h p l Th p t e t a s m
 p l t h l d f th p l p f e l m th
 ft wh h th p g d l l y t d d a t th
 l t f l w p m t v g t 0 3 th
 p t e t s t d t b t th p s e p c t l l a
 s e e a s t h e y e r b f th p t Th
 m p th t m y th f h d n l t g b f i c l
 f t th

CASE Th p t t w n m d m
 g d 4 y h t d th h p t l b c s e of
 p th l w p t f h b d m d g th
 f i t d f h m t l p o d H m
 b g h h w 7 y f g l h l w a y
 b g l Sh h h l d 5 y f g c
 th b th f h h l l th p th l p t
 f h b d m h b t t l y p e t Sh

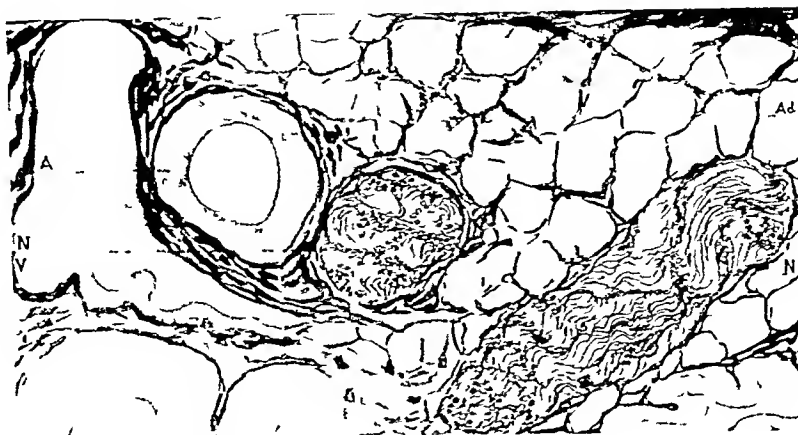


Fig 8 Neuromata in the pedicle of an ovary which showed marked sclerocystic degeneration (Mallory stain) A, Neuromata, V, vein, A, artery, Ad, adipose tissue (After Roux)

medical and gynecological treatment has failed to give relief. During the 2 months prior to admission to the hospital, the menstrual periods lasted about 10 days, but the pelvic pain began about 1 week before the period and continued for 8 days after the cessation of the menstrual flow. She has become very constipated but has had no urinary disturbances and no leucorrhœa. In 1926, while the patient was in Montreal she developed severe sharp pains in the right side of the abdomen. The history suggested cholelithiasis. Intensive medical treatment failed to give any relief from the attacks of pain. After about 4 months of such crises of pain she was submitted to a laparotomy. The gall bladder was found to be normal. The vermiform appendix, however, was found to be very adherent to the iliac fossa. Histological studies of this appendix by Professor Masson revealed the presence of many neuromata. Following the removal of this appendix the pains in the right iliac fossa disappeared completely but the dysmenorrhœa persisted in a somewhat milder form. She was referred to Professor Leriche in October, 1929, because of the dysmenorrhœa. Laparotomy was performed on October 17, 1929 (Pfannenstiel incision). The uterus was in second degree retroversion. The superior hypogastric plexus was isolated and a portion about 1 inch long was resected. The uterus was suspended according to the method of Doleris. The postoperative course was uneventful. She was discharged from the hospital on the twelfth postoperative day entirely free from abdominal pain. Follow-up examination was made on August 30, 1930. Her general health was excellent, she had gained 12 pounds in weight, and was much less constipated. She stated that she no longer had pains before, during, or after her menstrual periods. The menses were regular, about 4 days in duration, but the flow was still quite profuse. She stated that she had been

transformed into a new individual since the last operation. In February, 1931, 16 months after the operation, the patient was still free from abdominal or pelvic pain and in an excellent state of health.

CASE 15 This patient was a young married woman, aged 27 years, who was referred to the hospital with a diagnosis of chronic appendicitis. She had always been well and active until 1925 when she began having crises of lower abdominal pain. The pains usually remained in the lower part of the abdomen but occasionally radiated to the umbilicus. The crises of pain were usually associated with vomiting. Gradually the crises became more and more frequent until finally only a few days intervened between them. The pains have always been much more severe during or immediately before the menstrual period. The patient was treated medically for several months without beneficial results. Menses have always been regular. Recently they have become extremely painful and accompanied by incessant vomiting. General physical examination was negative. Gastro-intestinal X-ray studies showed no definite pathological lesion. Vaginal examination revealed the uterus in slight retroversion and the right ovary to be large and tender. Laparotomy (Pfannenstiel incision) was performed on December 13, 1929. Both ovaries were free but they showed marked cystic degeneration. The uterus was in second degree retroversion. The superior hypogastric plexus was isolated and a portion about 1 inch long was resected. The retrodisplacement of the uterus was corrected by the Doleris procedure. The appendix which appeared normal, was removed. The postoperative course was uneventful. The patient was discharged on the eighteenth postoperative day. She was entirely free from abdominal or pelvic pain. Follow-up examination on July 10, 1930, showed the patient to be in an excellent state of health. She had gained



Fig 7 Ph t m graph h w g m f g d
ll t r p o d b t w th fib f th p
t pl (d l R H t g ta) x 53

f m th h p t l th f t th p t p t
d y completely f e e f m l l b d m l p l c
p r Th b q t m t l p d s w e
regul r p l e s d l s t e d l y 3 t 4 d y l
J l y 93 p p m t l y m th a f t e the o p e
t i o n a h w a t i l l w t h t p d g h m t a l
p d H r g e r a l h l t h w a a c e l l e t d b
h a s g e d l i g h t l y g h t S h h h a d o
p h t d s t b A t t h e d f a g t
93 l a d t h a t s h a s s e e l m t h s
p n a n t l t h t t h p g c y a s p o g g
n o m l l y

CASE Th p t e t w v g m d
m a g e d 7 y a w h e t e d t h h p t l
b a u s e f m a k e d l a b d m i n l p s s o c t d
w i t h h e r m t l p e d H m m b g n h
h e w s b o u t 4 y a f g T h y h d l v b n
i r e g u l a p o f u e d u s u l l y l d b t w k
S e e c r a m p l i k e p a d t g t t h g h t l
f o a l y s m p n d t h m e e B f
t h f t l t t h e p a t t m t d f q e t l y d g
t h a t t a c k s f p s h e w n t t h h p t l
t h a d g n o o f h o p p d t Th
n e y t d m l e s p m t h
r g h t l o w q a d t f t h e b d m e s o t d
t h t h p l c p a P e l e m t l l
t h u t u t o b t h e c o d d e g f r t

N o t i n d e r n e s s a n d m s e s w e r f d i n t h
d l r e g o L a p t o m y w a s p f o m d o
N e m b e 8 10 9 T h t e n t h t o
v e t d p o t b t t w a f e l y m o a b l n d t
l d b e b r o u g h t t o t h e n m l p t s l y
T h e a d n w e r e f e b u t b t h a h o w d c o
s d b l e c y t c d g t i o T h e p h y p o
g s t r p l e x u w s e s e c t d t h l m T h e
t u s w s s u s p e d t h e n o m l p o s t
M a c c o p l l v t h a p p d r p p e d m l b t
t w a m e d n t h e r o t e m n T h p t t
m d e a n u v e n t f l p t o p t e r e y A t
t h e t m e o d c h g e f m t h e h p t l s h
t r l y f e e f r o m l l t h e f o m y m p t m d s h
b d o t o b l e w t h m c t t o n o d f r a c t a S h e
f a i l e d t r e t n f f u r t h f l l w u p a m t o s

CASE 3 Th p t t a a y g m d
m a g d 7 y e r s w h s r f d t t h e
h s p t l b e c u s e f e e e a b d m l d l m b r
p s s o c t d w t h h m t l p e r o d T h
p a n w e s o s e t h t h e w b l g d t g t
b d f t h f i t d a f h m e t l p r d
M n b e g n h h s 5 y e a o f a g a n d
e e l w a y l i g h t l y r g l a p f l d m o d
r a t l y p o f e S h h e b e e p e g t S h
g e o h t y f v e n a l d e s l v e e
a m t r e a l d t h t t b e f l y m a b l
d t h a d m l L p a t o m y (P f t l
c e r) p e f m d A p l 5 920 T h

u t e r u s w a d d g e e e t o T h
p h y p g s t c p l a r t e d t h e
t e m a n T h t p d d o r
m a l p t c c o d g t o t h e m e t h d f D l
T h e m f o m a p p n d w a t o p h c I t a s r
m o d t h l y T h p t p a t i v e r
e f f l A l l a b j e c t a s y m p t o m d s
p p e d a f t e r t h p t o n d t h m t l
p d h b m g l d l e p f e
F l l w p e m t n S e p t m b 193
y e a r a f t e t h e o p t i o n h o d t h p a t e t t o b
l l t b a l t h d t l y f r e f m p
d m f t d g h m t l p e d

CASE 14 Th a p t e t m e d m
a g d 36 y a w h o c a m t o t h e h p t l b s e f
p l p s o c t e d w t h h m n s t l
p e o d M e b g w h s h w b t 4 y r
f a g e T h y h l y b r e g u l p r
d f y t o 8 d a y d t S h h a d l w y h d
m d t l y p s p e e d i g a d d g t h e
f i s t p t f h m s t l p d S h h a b g
m d f y b t h h b p r g
t D g t h p t a y t h e p t h p l s
h a e g a d u l l y b m m t w t h h
c c d g m t l p d D g t h e 6 m t h
p t h e d m t t h e h p t l t h p e l
p n w s s e e t h t h w a o b l g d t r m
b d t h g h t t h t d t f t h
m t r u l p d T h p l e d e s b e d a
g t g d e p t h p l a d d t g
t l t o w d t h t a d d t h m e l l
p e c t f b t h t h g t d t h k e s S h h
b d p t h l m b r g I t

CASE 17 The patient was a married woman aged 30 years who was referred to the hospital because of dysmenorrhœa and vulvar pruritis. She had always been in good health. Menses began when she was 12 years of age and were always regular, profuse, and of about 5 days' duration. One child, aged 8 years, is living and well. One year prior to admission to the hospital she began to have aching pains in the lower part of the abdomen associated with marked leucorrhœa and pruritis of the vulva. There was no clinical or laboratory evidence of diabetes mellitus. During the past few months, the pains have localized in the right iliac fossa. Dyspareunia has been marked during the past 3 months. There is no burning on urination and no frequency of urination. Physical examination revealed marked tenderness over McBurney's point but without spasm of the abdominal muscles. Vaginal examination revealed a marked retro-displacement of the uterus. No abnormal masses were palpable in the adnexal regions. Laparotomy was performed on April 25, 1930. The presacral nerve was isolated and resected in the usual manner. The uterus was suspended in the normal position. The appendix was removed. During the post-operative course, the patient developed a phlebitis of the left leg which delayed her recovery for several weeks. At the time of discharge from the hospital, however, she was entirely free from the abdominal pain and pruritis of the vulva. Follow-up examination in August, 1930, 4 months after the operation, showed the patient in very good health and entirely free from all of her former complaints.

CASE 18 This patient was a young girl, aged 15 years, who was referred to the hospital because of severe lower abdominal pains associated with irregular menstruation. About 1 year prior to admission to the hospital an appendicectomy was performed but that operation did not relieve the lower abdominal pain. Menses began when she was about 12 years of age and remained regular and painless until February, 1930, when complete cessation of the menses took place. She was treated medically by injections of ovarian extract but without influence on the amenorrhœa. The past history shows that the patient has had frequent attacks of severe pain in the left iliac fossa at varying intervals since she was about 5 years of age. These attacks of pain have recently become more frequent and decidedly more painful. No vomiting or disturbances of micturition was associated with the attacks of pain. Examination of the urinary system was negative. There was no evidence of renal or bladder calculi. Laparotomy (Pfannenstiel incision) was performed on May 6, 1930. The abdominal and pelvic viscera were normal. The uterus was in the normal position. Exploration failed to reveal any cause for the crises of pain. The superior hypogastric plexus was isolated and a portion about 1 inch long was resected. The postoperative course was uneventful. She was discharged from the hospital on the fourteenth postoperative day. At

about the scheduled time in June her menses re-appeared without any associated abdominal pain. Menses have remained regular and painless. There were no urinary disturbances present until about the middle of July, 1930, 2½ months after the operation. At this time she returned to the clinic because of severe lower abdominal pain. Examination revealed a marked distention of the urinary bladder. Microscopical and chemical tests of the urine were all negative. The patient was catheterized regularly for 4 days after which normal micturition was again possible. She has been seen at regular intervals since that time and there have been no further urinary disturbances. Menses continue to be regular and painless. The pain in the left iliac fossa has completely disappeared. Follow-up examination in January, 1931, showed the patient to be in excellent health. She has gained in weight and has remained entirely free from abdominal pain or further urinary disturbances.

CASE 19 This patient was an unmarried woman, aged 21 years, who was referred to the hospital because of severe lower abdominal pain which was accentuated at the time of her menstrual periods. Menses began when she was 15 years of age and were regular and only slightly painful until 4 years ago when she developed acute salpingitis. Since then she has had considerable dysmenorrhœa and frequent exacerbations of the salpingitis. On September 4, 1928 she gave birth to an apparently normal child. An exacerbation of the pelvic inflammatory disease began with the menstrual period about 3 weeks before admission to the hospital. On admission to the hospital (April 23, 1930) her temperature was 38.5 degrees C. and she complained constantly of pains in the lower part of the abdomen. Pelvic examination did not reveal any areas of induration or any abnormal masses. Pressure in the cul-de-sac caused intense pain in the pelvis and pains radiating to the lumbar region. Medical treatment with tampons and hot douches was continued until June 2. The temperature fell to normal on the third hospital day but the pain persisted in spite of the vigorous medical treatment. Because of the persistence of the intense pelvic pain the patient was submitted to an operation. On June 3, 1930 the abdomen was opened through a Pfannenstiel incision. The uterus was in retroversion but it was freely movable. Few adhesions were present in the pelvis. The fallopian tubes were only slightly injected and both were patent. The superior hypogastric plexus was isolated and a portion about 1 inch long was resected in the usual manner. The uterus was suspended in the normal position. The postoperative course was afebrile and without incident. She was discharged from the hospital on the fifteenth postoperative day. Follow-up examination on September 10, 1930, 3 months after the operation, showed the patient to be in an excellent state of health. She had gained in weight. Her menstrual periods had been regular and painless. On rare occasions she has had a slight, dull pain



Fig. 9. The g. r. a. l. t. p. graphy f. t. h. l. m. b. h. w. g. t. l. t. f. t. h. p. e.
n. hypoga. tri. pl. tu. (p. esacral) t. t. h. b. f. cat. f. t. h. t. a. a. d. t. h. com.
m. l. es. l. Th. p. t. t. th. T. d. l. b. g. p. t.

16 p und s c e t h o p r t She had t m t d
s e the p at a d h m n t a l p o d h d
b me regula pa n l s m d e t e l y p f e b t
u u l l y f l y f w d y d r a t Sh h d n
d u t u b a f m c t t d e f a t She ha
h d 8 m o t h s f o m p l t i e f f o m p l a d
b d o m a l p

CASE 6 Th p t i e s a y o u n g u m e d
w m n a g d s e r h w f r r d t the ho
p t l b c f s e l w b d m l p a s
a t e d t h h m e t r l p a l M h a e
l w s b e r g u l a d t h f l o w h a s l y b n
p f s e Sh h s a l a y h d s d e b l p n
t h e l w e l m b r g n m m d a t e l y p d g a d
u s a l l y d u n g t h f t p t f c h m t l
p o d S m t m e b f o r d m u s s o t o t h h o s p t l
d l a t a t o n a d e t t g f t h t e r w d
b i t h e p l e p a a n d m e t a l d t b w e e

not impr d b t h a p e t P l c m
t n r e e l d o m p l t t n o f t h t r s
L p o t m y w a p e f r m d o F b a y 9 193
The t e t h d d g t r e The
d e a w e n o m a l Th p h y p o g t c
p l s w l t d a n d a p t a b o t c h i n g
e e c t e d The t d p l a m e n t f t h t u
w c t d b y t h p o c d u f D o l The
p p d w m d Th p t p e a t e
w s n e n f u l Th p t t d h g d f m
t h h o s p t a l t h e f u t e t h p o p e r t v d
Sh w a e t l y f e f o m p e l v i c a b d m l p
F l l w u p e m a t n J u e 03 4 m t h
b t t h e o p t h w d t h t t h e m s e h a l
f m m g u l p n l e s d m d e t e m t
Th p t n t h d b n w k i g e g l a r l y w t h t
t h l i g h t m n t f p l a b d o m l p a
t y t m e

pain One patient died on the second post-operative day Thirteen of the 15 patients that have been followed have declared themselves relieved of all pelvic or abdominal pain One patient has remained free from pain for over 4 years while one other has had no recurrence of her former symptoms during the 2½ years that have elapsed since the operation Two of the 15 patients that have been followed have had only slight or no benefit from the pelvic sympathectomy We believe that these results (Table I) justify the resection of the superior hypogastric plexus as a means of relieving severe pelvic and lower abdominal pains

RESECTION OF THE PELVIC SYMPATHETIC NERVES FOR THE RELIEF OF PAIN DUE TO INOPERABLE NEOPLASMS IN THE PELVIS

In 1925, Professor Leriche suggested the resection of the superior hypogastric plexus (presacral nerve) from its origin at the intermesenteric plexus to the lower part of the aortic bifurcation together with the resection of both lumbar sympathetic chains for the complete relief of the severe pain due to inoperable neoplasms in the pelvis Tisserand applied this procedure some time later, and he also obtained excellent results More recently, Ferey has advocated only the section of the superior hypogastric plexus for the relief of pain associated with extensive neoplastic infiltration in the pelvis In Roumania, Gomoiu (1920), Georgesco (1926), and Craiciu (1928) and, in France, Bernard and Theodoresco (1928) have reported excellent results in regard to relief of the pelvic pain by simple section of the superior hypogastric plexus The results published by Ferey (1929) showed that only partial relief of the pelvic pain was obtained by this simple procedure, however, he still advocates the procedure in every case in which an hysterectomy is performed for carcinoma of the uterus It is because of the fact that simple section of the superior hypogastric plexus does not always give complete relief of the pain that we have been advocating the more complete removal of the pelvic sympathetic nerves There is no great added risk in performing the complete pelvic sympathectomy as described by Profes-

TABLE I—SUMMARY OF THE RESULTS OBTAINED BY PELVIC SYMPATHECTOMY IN TWENTY-TWO CASES OF DYSMENORRHOEA AND HYPOGASTRIC PLEURALGIA

Case Age	Time interval between operation and last follow-up examination	Clinical results and remarks
1 15	4 years	Completely relieved of pelvic pain
2 30	4 months	Failure no improvement hysterectomy
3 41	5 weeks	No follow-up Complete relief in hospital
4 27	1-2 days	Patient died on 2nd postoperative day
5 0	11 days	No follow-up Partial relief of pain
6 33	16 days	No follow-up Relief during hospital stay
7 35	2½ years	Completely relieved of pelvic pain
8 39	0 days	No follow-up Relief during hospital stay
9 6	23 months	Failure no improvement
10 7	21 days	No follow-up Relief during hospital stay
11 19	10 months	Complete relief 6 months pregnant
12 17	11 days	No follow-up Relief during hospital stay
13 7	1½ years	Completely relieved of pelvic pain
14 36	16 months	Completely relieved of pelvic pain
15 7	8 months	Completely relieved of pelvic pain
16 3	4 months	Completely relieved of pelvic pain
17 30	4 months	Completely relieved of pelvic pain
18 13	5 months	Temporary retention of urine No pain
19 1	months	Completely relieved of pelvic pain
20 33	10 months	Complete relief 3 months pregnant
21 37	6 months	Completely relieved of pelvic pain
22 7	5 months	Completely relieved of pelvic pain

sor Leriche and one can be quite certain of complete relief from the most intolerable pelvic pains We believe that it is superior to cordotomy, since it gives complete relief from the pain without sacrificing any of the normal protective reflex pathways of the individual

The results which Professor Leriche has obtained by complete pelvic sympathectomy for

1 th left low quad nt of the abdome but it has e t f ed w th h ct tes T ther foll w up e mi t n 1 Jan a y 193 sho d that the ben ficl ffect of the op tion a f st ag Men w eg la panl ss a d of m d r t fl w The cr s of l cr bdom f p m h e complet ly d sappe ed

CASE 2 Thspt tent w s num red w m aged 5 yea who w sse ttle h p t l h se of se c d sm o r hce M es hegan hen sh wa 17 y s of ag and they w sway ul r prof se of 8 d y s d at o nd mod tely p f f In 19 g she g eb th to a m l full t m child S ce th b th f that hld he has had s vere low rabd m l pa ns wh ch re p cally m k d t th men tru lp ds She h sco t ed to hav a profu e leu hoca urina y disturba but ma ked st pat n Lap tomy s perfo med on J e 5 93 (P f enstil c son) The uterus s fo d i m r k d to v on B th

showed m de at cystic d ge r t The fllopan tub were jected b t they we p te t The su per or hypogast ic pl s wa i o l t d nd a g ment ab t r ch lo g wa esect d The uteru was usp nd d n th m lpo t The app dix was moved The p t per t u e w s un e t f l Follow up ex mnat on Sept mb o 193 sh w d the pat t to be m l t h lth Men e ere g l and painless The bd m l p unk d t ely d appe ed F l l w pexam a ton Mar h 93 led the f ct that th pa t e t bout 3 m ths p g t Me s had b n gula ut l the t f f the am hce of p e n y Th peg cvt p g g or mally Pat t h s h d o ab d m l p

CASE Th p t e t wa a ma d wom n ag d 34 ye who wa f d t the hosp t l b e of e d m hce l l m s beg h h wa 33 s f g d they h d alway b en egula p f a d m d t lypa f l Sh h s tw h lde l g d well g d 7 d 14 y respect ly Sh ha h d tw m c r g nd e ch w f llow d hy c t t g e f th ut f 9 he w p t d p n f a cvt f f the left o a y D g th pat y he ha h d se p th r ght l w q d t f th bd m w th each m t lpe d Th p very r d g th f r t d s f th m t f fl Th p lly c s th p t t t m t profusely Phys l m t eg t Vag al m t l d th f th t to b b l t lly l t d Th ght a y f f t som wh t l g th m l The t w freely m vable L p t my (P f t f) was p e f m d on J ly 6 193 Th t w 1 cond deg t r on Tl l f t f l p tube a d o ary w m g Th ht y l g a d h w d m k d y t c d g t A part l es ct (q d t) f th ght a y w do Th pe hypog t plexu sol t d and po t about ch f g a cet d Th ute s w susp d d the m lpo t Th

p stop tiv ou wa u e tful At the time of d cha ge f m the hosp t l the p t i was m pl t ly rel ed of l l h f me mplai ts R eated follow p m n a o sh w d the r l f f m t l pel c d abdom l p t b l t ing In J u y 93 the p t t as st l l f e f m p n

CASE Thspt tent sa r d m ged 54 v s ho wa ref ed to Prof o Leriche be u f sh p sho t p s i h l f l g a d m led p t s of the ul P r t her p ese t ill e s she h d lways been good h lth She h th ce child eaf g and ell V pa se occu d in 9 9 In J u y 193 sh d l ped phl b t s f the l f t leg thout app rent se The leg as imm bulz d d sh rema d in b d f r 3 m n th At the e d of th t tim he att mpted t g t of b d a d t up Sh rp sh t g p the l f t leg a d a bur g s ton the s c l r m n then app red A b r t m late sh d l p d p r t of the ulva Ge eral ph le m ion w s neg tve Vag le am t revealed a r y f m cervt b t no de ce of m l g t d s The ut s w s sm l l a d e f lv mov bl L p t omy a p f med on Ap l 9 193 by l f ssor Le ch The t s a l e e at phe Th e was n demon t bl se for the s pa n i the p l s d n the l f t leg A p arterial y m p th ctomy of the l f t omm l t j w s do e a d th s sympath ctomy co t ed up d a d s m f the pr t e a d p e t e sympath c e fibers v al m d l l eca of the great a cul ty of the dve tta f th a o t it w mp ssible to p e f m c mplet pe a t symp th ct my Th p or hypo gat c plex a th is o l t e d d m p l t ly resected Th p t per t e c r s s tful Th l f f m the so pa a m m d t d l t g O M y 6 93 h w d ch rged f om the hosp tal d nt lv fee f m l l f the f m pa s l f l w up m tons h e a b o th l f t bel st g A b o t g mo ths l t he d ghter wr te th f l l g t to My mother in ell t a t t f h alth he does n t uff y l g She rem sst d g al d f m 6 m ut l p m a d doe l l f h r hue w l

SUMMARY OF THE RESULTS OBTAINED IN THIS SERIES OF CASES

Fifteen of the 22 patients that have been submitted to a resection of the sup rior hypo gastric plexus because of some form of severe pelvic pain have had repeated follow up examinations over a lon period of time Six of the 2 patients have failed to return for follow up examination but at the time of di charge from the hospital they were com pletely relieved of the pelvic or abdominal

nosis of an inoperable carcinoma of the cervix uteri was made and the patient was given several courses of deep X-ray and radium therapy. During the month prior to admission to the hospital, the pains in the pelvis had been aggravated by the X-ray therapy. The pains had varied in intensity and location so much that it was impossible to localize the cause for the pain by clinical examination. Laparotomy was performed on November 15, 1929, by Professor Leriche. The neoplasm had extended into both broad ligaments of the uterus. The retroperitoneal lymph glands were large and hard. The lower part of the aorta was compressed by a large mass of stony hard lymph nodes. The superior hypogastric plexus was isolated, and a segment about 2 inches long was resected. Both lumbar sympathetic chains were sectioned at the level of the fifth lumbar sympathetic ganglion. The complete isolation of the lumbar sympathetic chains was made impossible by the large masses of hard, coalescing lymph nodes.

Following this operation the pains in the thighs and pelvis disappeared completely. There were no urinary disturbances following the operation, and defecation was normal. During the entire stay in the hospital, the patient failed to have any recurrence of the pain. She was allowed to return to her home on the twentieth postoperative day. We have been unable to trace the patient and consequently no further follow-up data can be obtained.

CASE 27. The patient was a married woman, aged 50 years, who was referred into the hospital because of excruciating pains in both thighs and in the left leg. In July, 1929, she developed phlebitis of the left leg, and a short time later the severe pains began in that leg. She was treated for sciatica for several months but finally she was referred to the neurological clinic where a very extensive carcinoma of the cervix uteri was discovered. Radium therapy was instituted but this only aggravated the pain. The sharp lancinating pains radiated to the anterolateral aspect of the left thigh. Laparotomy was performed on March 29, 1930, by Professor Leriche. An extensive neoplastic tumor was found in the pelvis and extending along the mesosigmoid. With some difficulty the pre-aortic plexus of sympathetic nerves was isolated and removed as completely as possible. The inferior mesenteric nerve was sectioned at the level of the fourth lumbar vertebra. The left lumbar sympathetic chain was isolated at this level and a portion about 1 inch long was resected, this portion included the right fourth lumbar sympathetic ganglion.

Following this extensive pelvic sympathectomy the patient was entirely relieved of all her former symptoms. She remained in the hospital until her death on September 14, 1930, and at no time did she complain of pain or discomfort. She was given 6 months of complete freedom from the excruciating pains in the legs by the pelvic sympathectomy.

CASE 28. This patient was a married woman, aged 58 years, who was referred to the hospital

because of constant pain in the pelvis with lancinating pains radiating down the anterior surface of the right thigh. Five months prior to her admission to the hospital, a diagnosis of carcinoma of the cervix uteri was made and the patient was submitted to radium therapy. The bleeding ceased after the radium therapy. About 2 months later she began to have sharp pains in the pelvis. These pains have constantly grown worse in spite of vigorous medical and radium therapy. The patient was also suffering from marked hypertension and an associated myocardial insufficiency. At the time of admission to the surgical clinic the pains were constant and very violent in character. After complete digitalization by the medical attendant, the cardiac condition was greatly improved, and an operation was advised. Laparotomy was performed on July 23, 1930. A large, irregular, stony-hard, retroperitoneal mass was found in the hollow of the sacrum. The internal genital organs were displaced anteriorly and immobilized by this mass. The peritoneum was adherent to the mass. Many of the pre-aortic lymph glands were enlarged, hard, and firmly adherent to the surrounding tissues. The pre-aortic plexus of sympathetic nerves was matted together by neoplastic tissue. As much as possible of this tissue was removed with the hope of removing the pre-aortic plexus at the same time. The superior hypogastric plexus was isolated and a segment about 2 inches long was resected. The right lumbar sympathetic chain was identified and sectioned just above the level of the fourth lumbar sympathetic ganglion. It was technically impossible to expose the left lumbar sympathetic chain in this patient. Following this operation the patient was completely relieved of all pelvic pain and throughout her stay in the hospital there was no recurrence of the pain in the pelvis or in the thighs. There were no urinary disturbances. The patient was discharged from the hospital on the twenty-first postoperative day. All of the former pain has completely disappeared. Repeated follow-up examination has shown the result to be lasting. In January, 1931, she was still without pain but she is gradually becoming weaker from the extension of the pelvic neoplasm. There has been no bleeding. This patient has had many months of comfort as the result of the sympathectomy.

PELVIC SYMPATHECTOMY IN RELATION TO THE CHRONIC ATROPHIC DISTURBANCES OF THE EXTERNAL GENITAL ORGANS

In 1921, Professor Leriche reported a case of kraurosis vulvæ which he treated by periarterial sympathectomy of the internal iliac artery. The patient obtained complete and lasting relief by this operation. Follow-up observations on this patient were made over a period of more than 5 years.

peritoneum is opened, the patient should be placed in the Trendelenburg position. The small intestines and colon can then be packed away easily toward the diaphragm. The extent and nature of the neoplasm should be determined at this time and a search should be made for the cause of the pain. The complete pelvic sympathectomy is then performed as follows: (1) Incise the posterior parietal peritoneum just over the lower portion of the abdominal aorta and remove all of the sympathetic nerves of the pre-aortic plexus from the origin of the inferior mesenteric artery to the promontory of the sacrum. (2) Isolate the superior hypogastric plexus and resect as much of it as possible. (3) Isolate the right lumbar sympathetic chain which is usually situated just at the lateral border of the inferior vena cava and resect at least two (usually third and fourth) of the lumbar sympathetic ganglia. (4) Isolate the left lumbar sympathetic chain which usually can be found just beneath the left border of the abdominal aorta and resect at least two of the lower lumbar sympathetic ganglia. After this neurectomy the peritoneum should be closed by a continuous suture of fine plain catgut. The abdominal wall should be closed in layers.

SUMMARY

The anatomical and physiological basis for the surgery of the pelvic sympathetic nerves in gynecology is now well established.

In the 22 cases of dysmenorrhœa or pelvic plexalgia, which have been presented, there has been complete and lasting relief from the pelvic pain in the great majority of the cases following the resection of the superior hypogastric plexus (presacral nerve).

Disturbances of micturition following this operation must be considered very rare. Clinical and experimental evidence has shown that the superior hypogastric plexus is essentially a pathway for afferent impulses from the internal genital organs.

The excruciating pain that is frequently associated with inoperable neoplasms in the pelvis can be completely relieved by an extensive pelvic sympathectomy. In all cases, even those in which the most extensive pelvic sympathectomy was performed, there have

never been any serious complications that could be attributed to the operation: no motor paralysis, no ascending urinary infection due to paralysis of the bladder, and no sensory disturbances of any part of the skin. Since this operation also gives the surgeon an opportunity of verifying the extent and nature of the neoplasm at the same operation, we believe that it should be used in preference to cordotomy for the relief of intolerable pain in the pelvis that is due to an inoperable neoplasm of any of the pelvic organs, provided the pain is not due to metastatic foci in the vertebræ.

The indications and the surgical technique for the various forms of pelvic sympathectomy have been described in detail.

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Crainicianu (1928) reported several excellent results of periaarterial sympathectomy of the internal iliac artery giving complete relief in cases of pruritus vulvæ. Two of our cases had marked pruritus of the vulva which was promptly relieved by the pelvic sympathectomy. Up until the present time pelvic sympathectomy has not been widely used in the treatment of the atrophic lesions of the external genital organs consequently all the data available at present are not sufficient to warrant any remarks concerning the efficacy of that form of therapy. The ordinary medical roentgenological and surgical methods in use at the present leave much to be desired in the final result of the therapy.

SURGICAL TECHNIQUE FOR RESECTION OF THE SUPERIOR HYPOGASTRIC PLEXUS (PRESACRAL NERVE OF LATARJET)

The abdomen may be opened either by a median subumbilical incision or by the incision described by Pfannenstiel. In young unmarried women we prefer to use the Pfannenstiel incision as the resulting scar is usually within the pubic hair line. The illustration of the surgical exposure (Fig. 9) shows the usual low midline incision being used. The type of incision through the abdominal wall is of course of little real importance. Before the peritoneum is opened the patient is lowered from the horizontal position to the Trendelenburg position. The small intestines and colon are packed upward toward the diaphragm. The rectosigmoid colon is then retracted laterally to the left. The uterus and adnexa should be examined to verify the diagnosis. The promontory of the sacrum and the two common iliac arteries are then located. The posterior parietal peritoneum is then incised at a point just above the promontory of the sacrum and directly in the midline. Immediately beneath the peritoneum and anterior to the mid sacral artery will be found the nervous filaments which constitute the superior hypogastric plexus (Fig. 9). In very thin women these fibers can be seen through the peritoneum while in obese women the plexus is usually embedded in much adipose tissue. If the mesosigmoid is short care must be taken not to injure the inferior mesenteric vessels. Fre-

quently several nerve fibers are densely adherent to the right iliac vein. After all the filaments have been isolated a segment at least 1 inch long should be resected from each main nerve fiber in order to prevent any possible regeneration. The posterior peritoneum is then closed by a continuous suture of fine plain catgut. Any supplementary operation that is indicated should be done at this stage of the operation. The abdominal wall should be closed in layers.

SURGICAL TECHNIQUE FOR PERFORMING THE PERI ARTERIAL SYMPATHECTOMY OF THE INTERNAL ILIAC ARTERY

The abdominal wall may be opened in the same way as has been described for the resection of the superior hypogastric plexus. Before opening the peritoneum the patient is placed in the Trendelenburg position. The peritoneum is then opened and the intestines are packed upward. The rectosigmoid colon should be retracted to the left. The common iliac artery is then located and followed peripherally to its bifurcation into the external and internal iliac arteries. The posterior parietal peritoneum is incised just over the internal iliac artery. For exposure of the common iliac artery the peritoneum is incised immediately over the artery at the point where the lumbo-ovarian ligament crosses the vessels. After the particular artery has been exposed one may facilitate the removal of the adventitia of that artery by injecting a small amount of normal saline solution directly into the adventitial layer of the artery. In that manner the periaarterial tissues will be distended and can then be easily removed by scissors or a sharp scalpel. After complete denudation of the chosen artery the peritoneum is closed with fine plain catgut. The abdominal wall should then be closed in layers.

COMPLETE PELVIC SYMPATHECTOMY FOR RELIEF OF PAIN DUE TO INOPERABLE NEOPLASMS IN THE PELVIS

The abdominal wall should be opened by an incision in the midline extending from just above the symphysis pubis to a point about 1 inch above the umbilicus. Before the

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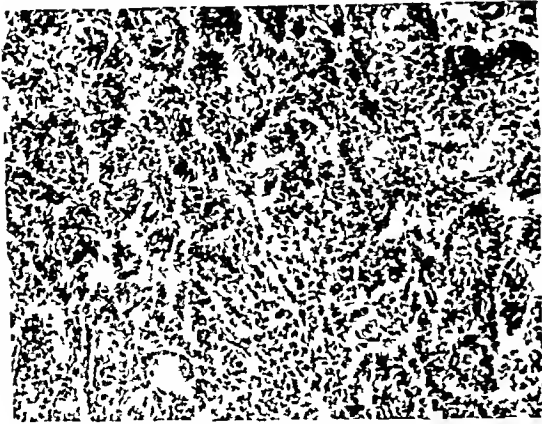


Fig 1 Squamous cell epithelioma, graded 3, of tongue, too active to be graded 2, differentiation (hornification) and so forth, in upper portion, and less differentiation in cells in lower right corner may be noted

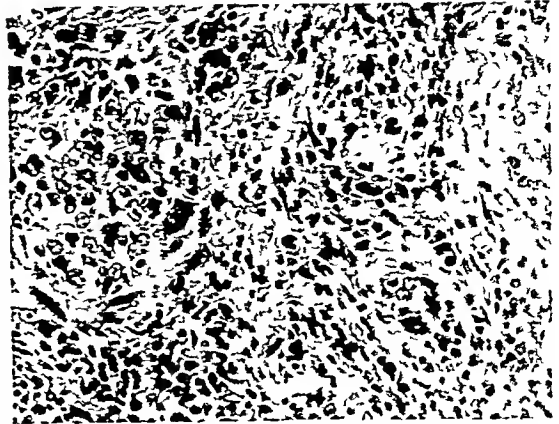


Fig 2 Cervical lymph node, squamous epithelioma, graded 3, primary lesion was in nasopharynx, large squamous cells infiltrating lymphoid tissue may be noted, lympho epithelioma was diagnosed previously

delicate cells with thin membranes, large nuclei and indefinite cell outline. They infiltrate the submucosa or lymphoid tissue in sheets or small groups or singly. In the nodes, the cells may reveal some traces of squamous characters or they may become less differentiated and the structure may resemble lymphosarcoma."

Sections from squamous epithelioma graded 3 (Figs 1, 2, and 3) show both undifferentiated cells and those of a more adult type of growth. Both are unmistakably squamous epithelial cells. The undifferentiated type predominates, however, and this is the basis for the grading of malignancy of the tumor. The same type of undifferentiated cell is seen in greater abundance in sections of lesions graded 4 composed of 75 to 100 per cent of undifferentiated cells (Figs 4, 5, and 6). It seems superfluous to call such growths transitional cell tumors. To do so is to create another type of carcinoma when there is no sound basis for doing so. It seems better that their identity with squamous cell tumors should be maintained. Regarding the diagnosis of endothelioma and branchiogenic carcinoma occasionally made in this type of lesion, we quote Saareste, who regarded endothelioma as a "refuge of the destitute" which has too often been resorted to when a malignant neoplasm of the upper air passages could not be definitely classified as carcinoma, sarcoma, or

mixed tumor (Fig 4). Ewing (7) expressed the belief that endothelioma of the lymph nodes is rare.

Hudson pointed out that writers in the past have erroneously attributed a branchiogenic origin to squamous cell carcinoma found in the neck near the angle of the jaw. Most of these undoubtedly were metastatic from lesions primary in obscure situations such as the nasopharynx, the primary lesion passing unnoticed.

It is likely that certain observers will disagree with us in the diagnosis of squamous cell epithelioma, graded 4, which is often called lymphosarcoma or Hodgkin's disease (Figs 4 and 5). Clinically, particularly as regards metastasis, there are some features common to both, and microscopically, too, it may be understood how some confusion might arise, particularly with regard to reticulum cell sarcoma (Fig 8).

The structure of lymphosarcoma is rather specific (6). It presents a diffuse growth of lymphoid cells lying in reticular tissue (Figs 7, 8, and 9). The structure of the affected node or follicle is obliterated. The cells vary in size, being small, medium, or large. The nuclei are compact or vesicular, always hyperchromatic, and nucleoli are not prominent. Two specific cells participate in the origin of lymphosarcoma giving rise to two specific forms of the tumor. These cells are the reticu-

HIGHLY MALIGNANT TUMORS OF THE PHARYNX AND BASE OF THE TONGUE

IDENTIFICATION AND TREATMENT

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THE most common malignant tumors of the pharynx and base of the tongue are the lymphosarcomata and the squamous cell epitheliomata graded 3 or 4. During a period of 14 years we have examined in The Mayo Clinic 1393 patients with such tumors. The present study is a review of 64 of these tumors which have been examined microscopically.

It is well known that certain highly malignant tumors of the nasopharynx, pharynx and base of the tongue are markedly radio sensitive and that some of these even in the presence of cervical metastasis have disappeared completely under irradiation. Such tumors we have classified as lymphosarcoma and highly malignant epithelioma.

IDENTIFICATION OF NEOPLASMS

Squamous cell epithelial growths of the pharynx are still sometimes misclassified endotheliomata and branchiogenic carcinomata. In recent years occasional disagreement as to their identity has arisen due to their having been described particularly by the Europeans as lympho epithelioma and by others as transitional cell carcinoma. Often too they are confused with lymphosarcoma. New and Kirch pointed out that lympho epithelioma and transitional cell carcinoma are in reality squamous cell epitheliomata graded 4. Schmincke is credited by Ferreri and Singer with the first clear histological description of lympho epithelioma. Good descriptions of the neoplasm are also given by Derigs, Ghon and Roman and Jovin (13). It is Schmincke's belief that the tumors are epithelial neoplasms of branchiogenic origin composed of a netlike syncytium of epithelial cells with lymphocytes

occupying the interstices. The syncytial epithelial cells and lymphocytes grow in true symbiosis according to Ferreri and Jovin (14). The same twofold structure occurs in metastatic growths although Jovin noted their frequent peculiar features of giving rise to purely epithelial metastasis at a considerable distance from the primary growth. It is not known why metastatic growths are not always of the same cell type as the primary lesion. It is indeed strange that on metastasizing a mixed lymphoid and epithelial cell type of neoplasm should lose one of its types of cell. It appears to us that the lymphocytes noted in the primary neoplasm are not a growing part of the tumor but are found there only because such cells are abundant in the mucous membrane of the pharynx and nasopharynx. Ewing (6) stated that lympho epitheliomata are in reality transitional cell carcinomata (also described by Quick and Cutler (24)). He stated too that the transitional cell carcinoma is the same tumor as that described by Crowe and Baylor and by New (18). These three authors called it squamous epithelioma. Ewing (8) stated:

The transitional cell carcinomata arise from stratified epithelium of which the cells are delicate without spines, do not produce keratin and show little capacity to hornify. This type of epithelium is found over the tonsil vault of the pharynx, nasal passages, base of the tongue and the nasopharyngeal sinuses. It often contains deposits of lymphoid tissue and hence has sometimes been called lympho epithelium. Very anaplastic and malignant tumors derived from adult squamous cells may exhibit the same clinical features. The structure of the growth shows sheets of large pale

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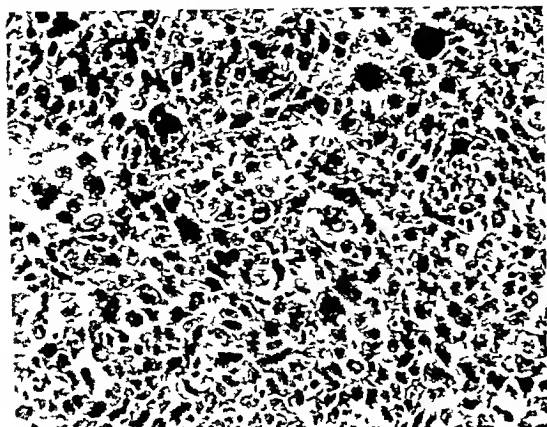


Fig 5 Squamous epithelioma, graded 4, of palate, mitosis present, lesion had been causing symptoms 6 months, patient had been treated previously for syphilis and trench mouth, and lesion was diagnosed sarcoma elsewhere

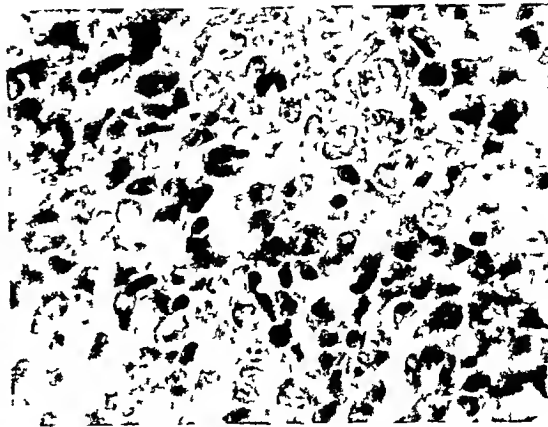


Fig 6 Squamous cell epithelioma, graded 4, of nasopharynx, on examination patient had bilateral enlarged cervical lymph nodes, noted for 3 years, and paresis of third, fourth, fifth, sixth, and eighth cranial nerves on right side and sixth cranial nerve on the left

common early symptom of lymphosarcoma of the nasopharynx probably because of its tendency to produce bulky growths. Four lesions, 2 of the nasopharynx and 2 of the tonsil, did not cause symptoms or signs and they were discovered in the course of general examination.

Woltman has shown that if there is involvement of a cranial nerve from a malignant lesion of the nasopharynx such involvement is likely to be multiple. In 31.8 per cent of 194 cases of lesions of the nasopharynx, there was cranial nerve palsy with an average of 2.9 nerves affected by palsy in each case. The sixth, fifth and ninth nerves were more often affected. Involvement of the nerves was highest in cases of lesions graded 3 and lowest in cases of lymphosarcoma. The latter is a softer, bulkier type of neoplasm, with less tendency to infiltrate.

Neoplasms of the hypopharynx were responsible in 33.3 per cent of cases for paralysis of the vocal cords. This explains in part why this group of lesions is one of the most unfavorable from the standpoint of selection for treatment.

DIFFERENTIAL DIAGNOSIS

The diagnosis is difficult to make. The possibility of malignancy at any age must be kept in mind. Enlarged metastatic lymph nodes

are most often confused with the enlarged cervical nodes of tuberculosis, leucæmia, and syphilis, or with the indurated swelling seen in actinomycosis, cystic tumors of the branchiogenic cleft or those originating in the thyroglossal duct, as well as benign or malignant enlargements of the thyroid gland, may cause confusion. A diagnosis in the presence of cervical metastasis should be easy if the primary lesion is found. In many instances it is overlooked. If discovered its nature is not always evident. Biopsy is usually indicated.

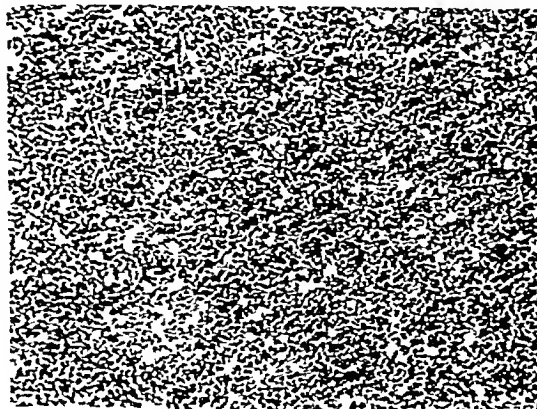


Fig 7 Lympho-sarcoma of inguinal lymph node. Both tonsils were involved, patient died, after 6 years, of sarcomatosis.

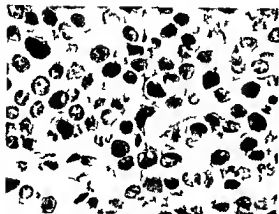
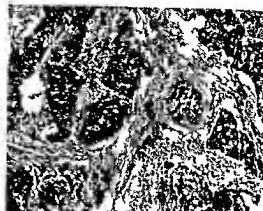


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lum cell of the germ centers of follicles and pulp cords and the lymphocyte. The two types of lymphosarcoma are reticulum cell sarcoma or large round cell lymphosarcoma (Fig 8) and malignant lymphocytoma (Figs 8 and 9).

GENERAL CONSIDERATIONS

In the last 14 years records have been made of 1,393 malignant tumors of the nasopharynx, oropharynx and hypopharynx, tonsil and base of the tongue. Only those lesions on which biopsy had been performed were reviewed. There were 624 cases in this group of which 78 were lymphosarcomata, 267 squamous cell epitheliomata graded 4 and 279 squamous cell epitheliomata graded 3. Thus it was found that high grade squamous cell epithelioma is about seen ten times as common as lymphosarcoma. Epitheliomata grade 1, 3 and 4 were approximately equally common.

About half of the lymphosarcomata and epitheliomata graded 4 were found to be primary in the nasopharynx. Lesions graded 3 were more often primary in the tongue (45.9 per cent). Only 18.9 per cent of all lesions were primary in the tonsil. This figure is roughly correct for the kinds of malignant tumors. Over 60 per cent of lesions of the hypopharynx were epitheliomata graded 3. There were no lymphosarcomata in this situation.

Of the 624 patients 84.2 per cent were males. The average age of 546 patients with

epithelioma was 52 years and that of the 78 patients with lymphosarcoma 45.2 years. Both lymphosarcoma and epithelioma were noted among patients aged less than 20 years. There were 15 such patients whose average age was 14 years. All of the tumors were primary in the nasopharynx except one of the tonsil. The youngest patient with lymphosarcoma was aged 4 years and the youngest with epithelioma was aged 3 years.

The average duration of the tumor before treatment in all cases was 9.6 months. In a few exceptional cases usually of lesions graded 3 the duration of the disease varied from 3 to 30 years. It seems probable that such lesions had arisen on the base of some other type of neoplasm such as mixed tumor which had undergone further malignant change.

SYMPTOMS AND SIGNS

Symptoms and signs of these malignant growths are often bizarre, particularly when the lesion is primary in the nasopharynx when they may be referred to the nose, ear, eye, throat, tongue, head or face. In many cases symptoms are secondary to lesions of the cranial nerves. Twenty-four and seven tenths per cent of patients with lesions in various situations and 4 per cent of those with lesions of the nasopharynx stated that enlarged cervical lymph nodes had been the first sign of trouble. Nasal obstruction as the most

TABLE I—ONE HUNDRED EIGHTY-TWO PATIENTS TREATED AND FOUR HUNDRED FORTY-TWO PATIENTS UNTREATED

	Treated		Untreated	
Lymphosarcoma				
Average age in years	46 0		43 8	
Duration of symptoms—months	7 5		7 5	
Metastasis on admission—per cent	61 75		77 25	
Previous operations elsewhere—per cent	50 0		70 5	
Squamous cell epithelioma—graded 4				
Average age in years	52 0		50 2	
Duration of symptoms—months	9 8		9 2	
Metastasis on admission—per cent	70 3		80 8	
Previous operations elsewhere—per cent	45 3		46 3	
Squamous cell epithelioma—graded 3				
Average age in years	54 8		55 1	
Duration of symptoms—months	7 3		13 8	
Metastasis on admission—per cent	36 9		82 0	
Previous operations elsewhere—per cent	23 6		28 2	
All types				
Average age in years	52 2		51 7	
Duration of symptoms—months	8 2		11 1	
Metastasis on admission—per cent	53 25		81 0	
Previous operations elsewhere—per cent	36 22		40 8	

Lesions in the hypopharynx were least favorable for treatment for only 7 68 per cent of these were treated. Growths of the anterior two-thirds of the tongue could be treated best (52 52 per cent), and malignant lesions of the tonsils could be treated next best (39 1 per cent).

Epithelioma and sarcoma of the pharynx, usually considered as primary in the tonsil, have been treated much the same, principally by surgical procedures (17). It is now recognized that lymphosarcoma is a highly cellular, undifferentiated radiosensitive type of tumor and it is agreed that irradiation is unquestionably the treatment indicated (1 4, 11 16, 18 21).

It appears that lymphosarcoma may definitely vary in activity, as does squamous cell epithelioma. On the whole it is more malignant and more radiosensitive than the active types of epithelioma. The necessity for general recognition of the fact that a large proportion of epithelial growths of the pharynx and tongue are of an undifferentiated, radiosensitive type of cell structure is apparent in the still common reports of treatment of series of cases of carcinoma in these regions. It appears that considerable treatment by operation, diathermy or cautery, is still being carried out

TABLE II—PATIENTS TREATED IN FIRST AND SECOND SEVEN YEAR PERIODS*

	1916-19 2			1913-19 9		
	Patients seen	Treated		Patients seen	Treated	
		No	Per cent		No	Per cent
Lympho-sarcoma	50	26	47 5	20	8	37 9
Squamous cell epithelioma graded 4	50	17	31 5	210	40	20 19
Squamous cell epithelioma graded 3	70	19	27 1	209	65	31 1
All types	179	60	34 6	405	116	26 1

*Four of the treated patients were not traced.

for lesions which might be better treated by irradiation alone. Only relatively few physicians have referred to the highly cellular, undifferentiated types of epithelial growths, which follow the law of Bergonie and Treboudau in their radiosusceptibility (2, 3, 6, 9, 23, 25). New (19) has pointed out that for epitheliomata of the pharynx, graded 3 or 4, radium alone is used if the lesion is too extensive for excision by cautery. For lesions of the tongue graded 4, the usual excision of the cervical lymph node is omitted, radiation alone being employed (15). Quick treated 473 patients with all types of carcinoma of the tongue variously situated. Of these, 23 (4 8 per cent) were free of disease for more than 5 years, some of them as long as 10 years.

We believe that some of the poor results obtained in the past in treating these lesions have been due in large measure to lack of care in selecting cases, omission of careful microscopic grading of carcinoma and lack of knowledge of the radiosensitivity of certain types. It is possible that these lesions may be activated by incomplete surgical procedures. Localized, accessible lesions of the tonsil, tongue, or pharynx may be excised surgically or by diathermy or cautery, followed by the insertion of radium directly into the wound by means of needles or emanation seeds. In the low grade lesions, this is followed by surgical removal of the lymph nodes of the neck which drain this area. If the primary lesion is extensive, with or without large lymph nodes, irradiation probably offers the only chance, which

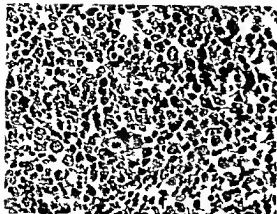


Fig 8 Rt il m lymph sa m of t f wh h
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m ed dms p t th d l g d m t t i
lymph des d g rad t (p l l t i
ly) death f m p m j m th l i

Although primary lymphosarcoma of the pharynx and leucæmia have some features in common at times an apparently identical microscopic appearance of the tonsil distinction is important from the prognostic standpoint. In leucæmia the lymph nodes are usually discrete painless and moderately firm similar to those in lymphosarcoma. In both conditions the cervical nodes may be massive but early in leucæmia there is generalized adenopathy while this is not true in the early stages of primary lymphosarcoma. In lymphosarcoma there is a locally destructive primary lesion and true metastasis occurs in distant organs. The two conditions are further distinguished by the blood picture accompanying leucæmia. In case of epithelioma graded 4 seen at the clinic it was found that the most common error in diagnosis was Hodgkin's disease.

TREATMENT

Selection of patients. In selection of patients for treatment (Table I) several factors are to be considered the most important of which is the type of lesion. The site and extent of the primary lesion and whether there is demonstrable cervical intracranial or general metastasis is also important. The probable duration of the disease and the amount and type of previous treatment may indicate whether the case is favorable. The age and

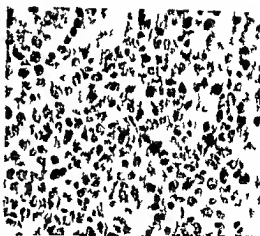


Fig 9 Lymph c m f b f t gu h h h d
b g ympt f o m th p t t d d s
m th ft m t D lymph sar m re
m l l th th f ep th l l growth th ect m j
b mp red w th F 3 d 6

general condition of the patient must be taken into consideration. Whether the patient will be able to remain under observation or return for observation and further treatment should the latter be necessary is important. He should be under the care of a competent physician who is equipped to give roentgen ray or radium treatment for 1 or 2 years at least.

Ideal cases were seldom encountered the incidence of cervical metastasis was high and the average duration of symptoms was long. Extensive lesions were seen in cases in which the history was short. In a number of cases patients who for various reasons fell into the unfavorable group were given one or several treatments for the palliative effect. These are classified as untreated. Later they will be separated from patients who actually did not receive treatment in order to show the effect of any of palliative measure.

Ratio of treated to untreated patients. The ratio was about the same for the two 7 year period over which the patients were observed (Table II). One hundred eighty-two (29.15 per cent) of 624 patients were treated. The most favorable lesions were the lymphosarcoma 43.6 per cent of which were treated the least favorable were epitheliomata graded 4 23.93 per cent of which were treated.

TABLE III—RESULTS BY SITUATION OF LESION

Site	Type of growth	Total patients	Patients treated									Patients not treated		
			Total	Traced		Living		Dead			Total	Traced		
				Cases	Average life, months	Cases	Average life, months	Cases	Average life, months	Final results		Cases	Average life, months	
Nasopharynx	Lymphosarcoma	40	15	13	37.5	10	75.5	1	51.0	10	9	11	5.2	
	Squamous cell epithelioma, graded 4	146	31	31	19.0	10	19.7	1	55.0	5	9	11	5.2	
	Squamous cell epithelioma, graded 3	23	7	7	19.0	10	19.5	1	55.0	5	9	11	5.2	
Pharynx	Lymphosarcoma	15	6	5	39.0	1	94.0	1	63.0	3	9	8	6.2	
	Squamous cell epithelioma, graded 4	17	3	3	21.0	1	9.0	2	69.0	1	1	1	6.8	
	Squamous cell epithelioma, graded 3	0	4	4	21.0	1	9.0	2	69.0	1	1	1	6.8	
Total	Lymphosarcoma	17	9	9	68.0	5	83.0	3	63.0	1	8	6	13.0	
	Squamous cell epithelioma, graded 4	15	15	15	20.0	10	41.0	1	55.0	1	10	2	0.1	
	Squamous cell epithelioma, graded 3	5	1	0	38.7	5	33.8	4	76.5	11	5	6	6.0	
Tongue (base)	Lymphosarcoma	6	4	3	68.0	1	17.0	1	63.0	1	2	2	5.5	
	Squamous cell epithelioma, graded 4	10	7	7	34.0	1	3.0	1	63.0	1	2	2	10.5	
	Squamous cell epithelioma, graded 3	8	24	23	33.0	9	60.7	3	7.0	11	10	21	8.1	
Tongue (anterior two-thirds)	Lymphosarcoma	11	11	11	30.0	3	37.0	1	63.0	1	10	10	6.0	
	Squamous cell epithelioma, graded 4	6	6	6	34.0	1	38.8	3	33.3	0	6	6	4.0	
	Squamous cell epithelioma, graded 3	11	20	19	34.0	1	38.8	3	33.3	0	19	19	4.0	
Hypopharynx	Lymphosarcoma	28	4	4	15.0	2	10.5	1	63.0	2	2	2	5.0	
	Squamous cell epithelioma, graded 4	10	10	10	1.5	1	12.0	1	63.0	1	10	10	5.0	
	Squamous cell epithelioma, graded 3	10	10	10	1.5	1	12.0	1	63.0	1	10	10	5.0	
All sites	Lymphosarcoma	28	24	24	47.9	11	83.0	0	9.0	13	103	103	6.0	
	Squamous cell epithelioma, graded 4	16	64	64	30.0	8	33.0	10	39.0	33	103	103	7.0	
	Squamous cell epithelioma, graded 3	29	82	80	33.0	3	40.0	10	60.8	18	193	17	0.8	
Total		64	18	16	3.5	71	4.1	19	9.0	95	19	33	6.8	

graded 4 were treated with irradiation. In 156 per cent of cases, surgical procedures alone were used, and in 26.55 per cent, surgical procedures and irradiation were combined in the treatment. Cervical nodes were excised in 16 cases.

Of the 28 patients who were treated and are alive, 17 (60 per cent) had palpable lymph nodes on admission, 15 (52 per cent) had had operations of various types, and the average duration of symptoms of the 28 was 10.2 months. The best results were obtained if lesions were in the anterior two-thirds of the tongue, 75 per cent of these patients being alive after 37 months. The next most favorable results were obtained if lesions were in the base of the tongue, 57 per cent of these patients being alive after an average of 43 months. Among the 28 patients living, 9 show evidence of malignancy. Of the 36 patients treated who died, 3 lived an average of 50 months after examination. One hundred sixty-eight patients not treated lived only 6.9 months.

Epithelioma graded 3. All lesions graded 3 situated in the nasopharynx were treated with

irradiation, usually with radium. Thirty-two and five-tenths per cent of all lesions graded 3 were treated with irradiation. Surgical procedures alone were used in 11.44 per cent. Irradiation and surgical procedures were used in various combinations in 56.25 per cent.

Of the 32 patients still alive, 10 had palpable cervical lymph nodes on admission, 6 had been operated on, and for all the average duration of symptoms was 7 months. Two of these lesions, involving the tonsil, were discovered accidentally following tonsillectomy. Six of the 32 living patients still showed evidence of malignancy, but 3 patients have been free of the disease more than 8 years.

The best results were obtained if lesions were of the anterior portion of the tongue, 50 per cent of patients being alive after 38.7 months. Better results were obtained if the lesions were of the hypopharynx, but only a small percentage of these lesions were treated. Of the 48 patients treated who died, 10 obtained good results, they lived an average of 60.8 months. The remaining 38 averaged 10.7 months of life. The average life of all treated patients who died was 28 months.

is palliative only. Radium needles or emanation seeds may be used for the primary lesion when it is infiltrating. Needles or emanation seed should not however be used for a primary lesion which has extended so that there will be danger of severe hemorrhage subsequent to the separation of the slough unless the external carotid has been ligated. In such cases radium applied to the surface of the growth is indicated. Surface irradiation is the usual method used for lymphosarcoma. However needles are frequently inserted directly into the local tumor in addition to the application of deep roentgen rays externally. The dosage must be carefully measured for even with radium used in this manner too large a dose may produce dangerous sloughing. With extensive lesions palliation is all that should be expected of any form of treatment. Too often patients present themselves with extensive primary lesions encroaching on the deeper vessels. Ligation of the external carotid artery may be the first step necessary in prevention of a fatal hemorrhage from a large eroded vessel.

In the nasopharynx radium applied to the surface of the neoplasm should be the only therapeutic measure for either type of growth. In the oropharynx and hypopharynx a few cases may be encountered in which the primary lesion is small enough to be destroyed with diathermy or the cautery but these are exceptional. Usually the emanation seeds are the best form of treatment for epithelial lesions of the oropharynx and hypopharynx. Lesions of the hypopharynx which are not easily accessible to seeds or needles as is often the case may be treated with surface irradiation.

If the primary lesion is graded 3 and cervical nodes are palpable partial or complete block dissection of the node may be done. This is preceded and followed by irradiation and with radium. If the primary lesion is graded 4 radium alone is as a rule used to the neck whether lymph nodes are or are not palpable. Radium needles or emanations are not used for the regional nodes for the trauma incident to their insertion is likely to stir up too active a process and accuracy of insertion is questionable. Roentgen rays were used in

some instances. Usually however such treatment was reserved for palliation or when expediency was desirable.

Previous operative treatment. Of 467 patients treated elsewhere 46 (39.4 per cent of the series of 64) had been operated on and 308 operations had been done. Patients with lymphosarcoma had had relatively the greatest number of operations 96, 3 per cent of patients with lesions of the nasopharynx had been operated on. Of 185 operations in cases of malignant lesions of the nasopharynx the most common single operation was tonsillectomy (39). The largest group of operations were those on the nose (56) which included operations on the maxillary sinuses as well as removal of polyp turbinates or septum. Cervical lymph nodes were operated on in 33 cases and teeth were extracted in 20 cases. In a few of the cases mastoidectomy or myringotomy and injections of alcohol for trifacial neuralgia had been done.

Of 432 patients with malignant lesions of the tonsil pharynx hypopharynx and tongue 112 had been operated on 123 times. The operations most commonly performed were removal of tonsils cervical lymph nodes teeth and tumor. Only 4 of the 467 patients treated previously had had biopsy.

Previous non operative treatment. A great variety of methods of non surgical treatment was used. Local treatment to the throat comprised 31.46 per cent anti syphilitic or serum treatment often given in the absence of a history or positive blood test for syphilis comprised 11.61 per cent. Internal medication intravenous medication baths Chinese herb and a fair amount of treatment by light had been used. In some cases other methods of healing as practiced by followers of Abrams chiropractic naturopathy and osteopathy were employed. Roentgen rays were employed in 20.05 per cent and radium in 14.25 per cent.

Patients traced. Of the 624 patients 89.2 per cent were traced the percentage was higher (96.7 per cent) among treated patients.

Epithelioma graded 4. All lesions graded 4 situated in the nasopharynx were treated with irradiation usually with radium. Seventy-one and seven tenths per cent of all neoplasms

tion It might be possible that a similar, larger group would show similar results Only then could it be settled definitely whether the good results were the result of the treatment or of the selection of patients Although treatment appears to be all important it must be concluded that good results may be due to one or both of two factors the treatment and the selection of the patient

Palliative treatment To determine the effect of palliative treatment in prolonging life, the group which included the untreated patients and those given palliative treatment, was divided into two groups, one included patients who received one or a few palliative treatments, and the other included those who had not been treated, as far as could be ascertained It appears that unless the patient is seen early enough to be offered adequate treatment, it is just as well not to give any, as far as prolonging the patient's life is concerned The average life in months of patients receiving palliative treatment was 6.9 months, and of those not receiving palliative treatment, 5.8 months

In determining the prognosis of the patients in this series, the duration of symptoms of all traced patients was added to the length of life following examination The life expectancy of all treated patients from the onset of symptoms was 42.7 months, and of all untreated patients 17.9 months The prognosis for untreated patients is not as good for patients with lymphosarcoma and epithelioma graded 4 as it is for those with epithelioma graded 3 It was noted, however, that lymphosarcomata responded better to treatment than either of the epithelial neoplasms

MORTALITY

The death rate (Table V) illustrates the variation in the degree of malignancy of the three types of lesions The rate was calculated from the number of months the patients lived after treatment in order to avoid the higher percentage obtained when the rates are calculated from years of life The rates show the effect of treatment

Almost all of the deaths (96 per cent) were due to malignant neoplasia In cases in which treatment was given the percentage of deaths

due to malignant neoplasia was slightly less (90.5) than the percentage of these deaths (97.52) in the untreated group Most of the deaths attributable to the malignant process were due to the local disease rather than to distant metastasis

SUMMARY

The most common highly malignant tumors of the nasopharynx, pharynx, and tongue are the lymphosarcomata and epitheliomata graded 3 or 4 The latter have often been described as lympho-epitheliomata or transitional cell carcinomata, and are at times, miscalled branchiogenic carcinomata or endotheliomata

High grade squamous cell carcinoma is about seven times as common as lymphosarcoma The latter is the most common type of sarcoma of the pharynx Lymphosarcoma and epithelioma graded 4 are more often primary in the nasopharynx Epithelioma graded 3 is seen more often in the tonsil, tongue, and hypopharynx

Eighty-four and two-tenths per cent of all lesions occurred in males The average age of patients was 52.1 years A few of each type of lesion occurred among patients aged less than 20 years

Twenty-four and seven-tenths per cent of all patients noted enlarged cervical lymph nodes as the first sign of the disease On examination at the clinic, 71.4 per cent had cervical metastasis

Thirty-one and eight-tenths per cent of lesions of the nasopharynx were complicated by cranial nerve palsy Thirty-three and three-tenths per cent of lesions of the hypopharynx were complicated by palsy of the vocal cords Symptoms and signs varied considerably in cases of lesions of the nasopharynx

Twenty-nine and two-tenths per cent of all patients were treated There was not much difference between treated and untreated patients, 74.95 per cent had been treated previously, and 39.42 per cent had been operated on previously

A great variety of surgical and non-surgical treatment had been given previously in almost all cases, without the proper diagnosis having been made Patients were treated at the

TABLE IV.—PERCENTAGE OF TRACED PATIENTS FREE OF RECURRENCE THREE TO ELEVEN YEARS AFTER TREATMENT

	Cases	Three years		Five years	
		Cases	Per cent	Cases	Per cent
Lymphosarcoma		5	68		53
Squamous cell epithelioma	6			6	6
Squamous cell epithelioma	20		5	5	8
Total	6	8	7	3	83

That lesions graded 3 are not as quickly fatal as those graded 4 is indicated by the fact that the 10 patients with epitheliomata graded 3 lived more than 5 years. That the 5 year cure is unreliable is indicated by the fact that 6 of these 10 patients died of carcinoma. They lived an average of more than 6 years. Indeed one patient lived 7 years and 6 months. One hundred seventy five untreated patients lived an average of only 6.8 months.

Lymphosarcoma. The treatment of lymphosarcoma consisted of irradiation except in 3 cases in which the tonsil were removed surgically before the radium was given. Half of the patients treated had had operations elsewhere. These did not get along as well as the other half. The length of life after examination as well as the percentage of living patients differs in favor of irradiation alone. Only 18.7 per cent of patients operated on previously are alive 6 years or more whereas of those not operated on previously 50 per cent are alive 6 years or more. The average life of all patients in the group treated with irradiation alone exceeds that of the others by 20.9 months.

Of the 11 patients living on examination 6 (54 per cent) had palpable cervical lymph nodes on admission and in 1 of these enlarged abdominal nodes were present. Three patients (73 per cent) had been operated on previously. The average duration of symptoms of the 11 was 6.8 months. The average length of life from onset of symptoms to the present of patients who have been treated has been 9 months (more than 7 years).

TABLE V.—DEATH RATE

	Treated patients		Untreated patients	
	Deaths from malignancy	Deaths from all causes	Deaths from malignancy	Deaths from all causes
Lymphosarcoma	5	3.68	5	5
Squamous cell epithelioma	6	5		5
Squamous cell epithelioma	5	5	7	

*The death rate as here presented in percentage, based on the number of patients who died of the disease.

The highest percentage of living patients was noted in the group whose lesions were of the tonsil in which 55 per cent have been alive 83 months. Of the 21 treated patients who died 6 obtained fairly good results with an average life of 59 months after examination. The remaining 15 averaged 18 months of life.

That the current 5 year cure sought in treating carcinoma is unreliable is again indicated by 5 patients who were treated at the clinic. All died of malignant lesions from 41 to 72 months after examination, an average of 56 months after examination. One patient lived more than 6 years and died of diffuse sarcomatosis.

All lesions (Table III). Twenty nine and sixteen hundredths per cent of the 64 patients were treated. Of the 176 patients who were treated and traced 71 (40.3 per cent) were alive an average of 43.1 months later. Nineteen (10.8 per cent) lived for 59 months. Eighty six (48.8 per cent) lived for 19.9 months. All treated patients who were traced lived an average of 34.5 months. All untreated patients who were traced lived an average of 6.8 months. Treated patients lived almost 19 times as long as those not treated. Treated patients who lived 3 or more years are subdivided according to the number of years they lived: 27.4 per cent of treated patients lived 3 years or more after treatment and 18.28 per cent lived 5 years or more after treatment (Table IV).

The ideal study would include a series of cases preferably of early lesions which would be observed untreated over a period of months or years. Of the 44 untreated patients 4 were alive 26 months after examination.

THE SCIENTIFIC AND SOCIAL ASPECTS OF ORTHOPEDICS¹

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AT the end of his admirable life Sir James Mackenzie justly said "A lack of guiding principles is responsible for many haphazard methods. The result, too often, is that though immense energy is expended, achievement is not commensurate with this expense." There is a consensus of opinion that the medical sciences stand more than any other in need of such principles. It will now be my purpose to sketch some rules which orthopedics has contributed, and in so doing I shall have to restrict myself to those which bear reference to the formation and the growth of bone.

When Andry in 1741 composed the word "orthopædics" and published the first booklet under this title, there was no reference to biological laws and rules. Congenital wry-neck is treated by massage with lukewarm wine and oil, the scoliotic kyphos by gently pressing both hump and chest. Spreading the arms by holding the ends of a long stick, is considered to lead to a flattening and a lengthening of the clavicles. The idea that such slight forces would cure deformities, implied a proportional fear of such forces acting on the normal body. Warning is given to avoid any more or less forcible pressure from the hands of the nurse or the wrappings of the child, and the application of oil or grease on the skin is recommended in order to soften the bones. Here we find orthopedics in a pre-empiric stage—a stage in which it remained for a whole century.

In the end of last century Hueter and Volkmann set up a rule according to which growth is retarded whenever pressure exceeds the normal, and growth is accelerated whenever pressure is diminished. It is known as Hueter-Volkmann's pressure theory, though pressure rule seems to be the better term. In what follows I shall try to prove that this rule refers only to a special case out of a number of possibilities. Nevertheless, it was a valuable contribution toward an insight into the cause of deformities, being the first allusion to muscle action and gravity as physiological stimuli to

bone growth. It did not escape Volkmann's attention that the same difference in pressure caused a difference in growth in some cases and not in others. Therefore, he justly added that besides excessive or prolonged weight-bearing a weakness of the tissues especially of the bone tissue, played a part in the development of the growth difference. The nature and the cause of this weakness, however, he did not define. Moreover, Volkmann realized that, quite apart from growth, excess of weight-bearing might lead to deformity in preformed bone, viz., by causing primary absorption of lime salts and secondary plasticity. He called the process interstitial absorption, a name also used by Hunter, though in a different sense. All this marks Volkmann as the first to give rules regarding the effect of mechanical stresses on the growth and the formation of bone substance, simple though they were.

In 1892 Julius Wolff's epoch-making book, *The Law of the Transformation of Bones*, was published, in which Wolff claimed to disprove what Hueter and Volkmann had asserted. Only a small portion of Wolff's transformation law has proved to be tenable viz., the fact that the elements of the cancellous tissue modify their width and their direction, when the intensity and the direction of pressure stresses are modified. Those elements which no longer have to transmit functional stresses become thinner or disappear altogether, while in the direction of the modified stresses existing elements thicken or new elements are formed.

Tension stresses to which Wolff ascribed the same function, appear to constitute no trophic stimulus to bone. The mathematical-functional form of bones, which he proclaimed, and which ascribed to the bone substance a malleability not unlike that of the pre-empiric stage of orthopedics does not exist. Some bones, viz., the protecting bones, e.g., the cranium, develop without the action of functional stresses. Even the supporting bones

¹Lady Jones Memo. of Lecture delivered at Liverpool February 17, 1931.

clinic by irradiation. Surgical procedures dia-
thermy or cautery were used with this in
selected cases. Lymphosarcoma was treated
almost entirely with irradiation.

Eighty nine and two tenths per cent of the
patients were traced. Seventy-one (40.3 per
cent) of patients treated were alive after an
average of 43.1 months. Nineteen (10.8 per
cent) of patients treated lived 59 months.
Eighty six (48.8 per cent) of patients treated
lived 19.9 months. Sixteen and forty eight
hundredths per cent of all patients treated are
alive 3 years or more.

All patients treated averaged 34.5 months
of life after examination and all patients un-
treated averaged 6.8 months of life after ex-
amination. A higher percentage of patients
with epithelioma graded 4 are alive than of
those with lymphosarcoma but the duration
of life after examination is longer in cases of
lymphosarcoma.

Palliative treatment had little if any effect
in prolonging life. The life expectancy from
onset of symptoms of all patients treated was
42.7 months. The life expectancy from onset
of symptoms of all patients untreated was 17.9
months. Of those who died 96 per cent died
of the malignant process the local lesion
causing the death of 84.5 per cent.

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54
4 Q u D L A S d C u l M T u a l
l l m m d t t r a l t m
B t J R d l 97 x 45435
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8 S I G Z p h l l g s c h A t m
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Fig 1 For explanation regarding percentage of inorganic salts in dense and rarefied tissue of concave side of lateral curvature, see Table I

G S, digger, 27 years

	Right	Left
Semilunar	85 mm	75 mm
Scaphoid	30 mm	27 mm

The dimension of these bones is reduced in the direction of the acting muscle forces without any noticeable irregularity in their structure, just as in the semilunar during the initial stage. This fact can hardly be understood unless plasticity through enhanced absorption of lime salts be admitted. It may be adequately termed *plasticity through excessive weightbearing*. As the semilunar bone is most exposed to the muscle forces which converge over both its dorsal and volar surfaces, it is the only carpal bone to undergo further deformation. At a given moment it is fractured by a forcible jerk or even imperceptibly. The

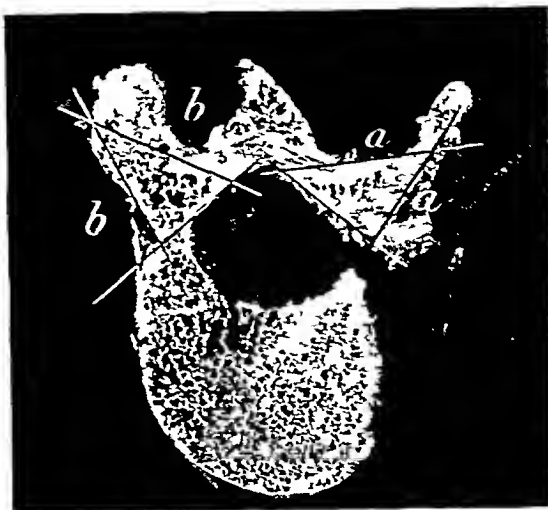


Fig 2 For explanation see Table II

X-ray film then shows irregularities mostly dense transverse striae in the structure of the semilunar. One or more light spots are seen to develop through absorption of lime salts as is usual in the case of fractures, when the fractured ends are approached by blood vessels (Leriche and Policard). The infraction thus evokes increased plasticity and initiates a vicious circle. *Plasticity through fracture* develops on the top of *plasticity through excessive weight bearing*.

If we are right in assuming that subnormal as well as excessive functional pressure is associated with absorption of lime salts in bone, it is between these extremes that the enhanced deposition of lime salts takes place. It then follows that in cases in which increased function is demanded, this increase should be made gradual, in order that time for the additional deposition of lime salts be allowed. Thus the available evidence favors the assumption that in training for sports the skeletal parts are no less benefited than the muscles, i.e., that the bones are "trained" as well as the muscles.

Of greater importance than the rules already mentioned for the formation of bone are those for the growth of bone. In the first place there is the law of the vulnerability of rapidly growing cell groups, which, although regarding growth generally, plays an important role

TABLE I—EXPLANATION OF FIGURE 1

Th d	se t ss	n co ta	W ter	Ashes (lc l ed f m th h dr b tan) pe
Th d	ti s	n c tain	x 3	6 5 63 6
Th	po gy ti	δ ta ns	6	49 4
The	po gy t	δ ta		56 4
D ff	c			9 6

Qu it exp d p c t e f w ight

will develop and maintain themselves apart from such action although less completely. Under the influence of these stresses the supporting bones will form more bone than is needed to resist them. Moreover the softer parts have their influence on the form of bones since bone tissue has been proved to display a tendency to yield to the lateral pressure of neighboring tissues. Hueter Volkmann's pressure rule was not disproved by Wolff since it deals with growth and Wolff has nowhere separated the growth of bone from its formation. Wolff's opinion that the formation of bone is always proportional to the intensity of the acting stresses appears to be untenable as opposing Volkmann's interstitial absorption under excessive pressure. Wolff overlooked the fact that a physiological curve has both a descending and an ascending part.

It has recently been shown that the dense bone tissue in a vertebra on the concave side of a lateral curvature contains a higher percentage of inorganic salts than the rarefied texture in the concave side. For example in the vertebra of Figure 1 this difference amounts to 9.65 per cent of the anhydrous substance in that of Figure 2 to 6.2 per cent and in another scoliotic vertebra it amounted to 8.0 per cent of the anhydrous substance. Hence to an increase of pressure the deposition of lime salts in bone rises more rapidly than the deposition of the colloid substances. To a decrease of pressure radiography produces evidence favoring the assumption that the bone elements not only grow thinner but that moreover their translucency to X rays increases disproportionately. In representing this graphically by noting functional pressure in the horizontal and the formation of bone on

TABLE II—EXPLANATION OF FIGURE 2

Th d	t ss	tain	W ter	Ashes (lc l ed f m th h dr b tan) pe
Th d	ti s	n c tain	9 t	6 5 63 6
Th	po gy t ss	in δ co ta	9 7	60 8
Th	po gy t	δ c t	3	5 6
D ff				0

Q ant ti xp sed p c t e f w ight

the vertical line we obtain two ascending lines which cross in *P* at a normal pressure ($= n$) (Fig. 3) the line starting from *C* representing the deposition of colloid substance the one from *S* that of the lime salts. It may be assumed that these like other physiological curves have a descending as well as an ascending part denoting that to an ever increasing pressure both the colloid substance and the lime salts cease to be deposited and start being absorbed. Moreover it seems justifiable to assume that these descending part will show a difference in steepness. Hence it seems probable that to an excess of pressure ($= O$) the absorption of lime salts exceed the absorption of the colloid substance i.e. that a condition of plasticity of the bone substance develops to an excess of pressure.

Some hitherto obscure phenomena in the life of bone tissue appear as the result of such plasticity. For example the slight flattening of the femoral head in the wide (or the flat) hip-socket and the characteristic local deepening in the socket roof during the initial stage of coxa plana i.e. long before the fragmentation stage. Also the so called malacia of the semilunar bone in artisans whose occupation demand forcible manual labor. A recent investigation has shown that in so called malacia of the semilunar bone other carpal bones such as the scaphoid the trapezium and the trapezoid too may show a shortening (Figs 4 and 5).

In 2 other cases both the semilunar and the scaphoid were found to be shortened

I U c p e t r year

	R. h	Left
S m l r	7 5 mm	8 5 mm
S p h d	mm	24 mm



Fig 4 G K, cobbler of 30 years In the left wrist the semilunar measured 9 millimeters the scaphoid 23 millimeters, the trapezium 11 millimeters, and the trapezoid 10 millimeters, in the right wrist the semilunar measured 7 millimeters, the scaphoid 20 millimeters, the trapezium 10.5 millimeters, and the trapezoid 9 millimeters



Fig 5 A W, nurse, aged 33 years In the right wrist the semilunar measured 10 millimeters, the scaphoid 20 millimeters, the cuneiform 16 millimeters, in the left wrist, the semilunar measured 7 millimeters, the scaphoid 18 millimeters, and the cuneiform 18 millimeters

The question arises what is the special position of vitamins among the injurious agents affecting growth?

The experience gathered from the study of tetany, has taught that vitamin D cures tetany only if the parathyroid glands are present. If these glands are removed, the vitamins remain inactive. This furnishes ground for the assumption that vitamin D exerts its influence on calcium metabolism through these endocrine glands. And the hypothesis seems justified that the influence of vitamins on bone growth generally is an indirect one, it being directed to the endocrine glands. For example, the presence of vitamin A might be essential for the normal function of the pituitary. In other words, there is evidence favoring the assumption that the food hormones A and D are distributed from the great storehouses constituted by liver, kidneys, and other glands over the various blood glands, and stimulate these organs to produce their specific gland hormones. Hence, even in the face of the vitamin conception there is no denying the possibility that insufficiency of the function of the blood glands may be due to an enfeeblement of these glands, i.e., a primary deficiency of gland hormones as well as to a primary deficiency of food hormones. This is another reason why the identification of rickets and vitamin deficiency is not justifiable.

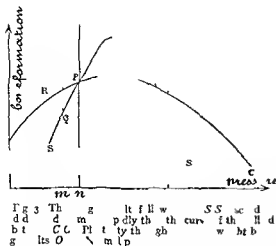
Hence, the improvement obtained by the administration of vitamin D in cases of rickets in which vitamin deficiency may be excluded, may be the result of enhanced stimulation of enfeebled blood glands by an extra dose of these food hormones. In this connection it may be appropriate to mention that Marfan is opposed to the identification of rickets and vitamin deficiency on the ground that, although vitamin D causes the disappearance of changes in the bones, especially those near the growth cartilages, the hypotony of the muscles the nervous troubles and the retardation of growth improve less rapidly and no influence is exerted on the concomitant symptoms, viz on the anemia and the changes of the lymphatic system.

Two considerations reveal the importance of the dissimilarity of rickets and vitamin deficiency. First,

if rachitis were, indeed, merely a vitamin deficiency distribution on a large scale of irradiated ergosterol and its administration to young children would be the easy way of dealing with the problem of its eradication, whereas, if we are right in assuming that, apart from vitamin deficiency rachitis may be the outcome of an enfeeblement of the power of growth, the various obnoxious agents will have to be traced and forestalled in the combat against the condition. Second, the study of rickets if limited to the study of vitamin deficiency, largely debars us from the study of the laws of growth.

In Figures 6, 7, and 8 the three types of feebleness of growth are represented. In each of these families fatigue of the mother during pregnancy was the only injurious influence traceable. Obviously the symptoms of feebleness of growth run parallel with this obnoxious agent. In the families H and F there is an increased fatigue at each successive pregnancy. In the family v d H the feebleness of growth increased more rapidly, the third and the fourth child being unable to survive. The mother, an energetic woman, used to sit up sewing late at night to add to her husband's small income. After the early death of the two children there is a notable improvement of the power of growth in the fifth child, which, however decreases again with every succeeding child. Only the last child grows a little better than the previous one, the mother having had a month of rest during pregnancy.

The severe form of feebleness of growth belongs to the first years of life. Unless a chronic obnoxious influence, e.g. a chronic enteritis, keeps enfeebling the child, the condition regularly improves, even apart from treatment.



in the growth of bone tissue. This law consists of two articles.

1. Injurious agents affecting growing cell groups enfeeble their power of growth. In other words feebleness of growth may be brought about by all kinds of injurious agents.

The measure in which growth is enfeebled is proportional to the rapidity of growth, i.e. the sign of feebleness of growth are proportional to the rapidity of growth.

This holds good for the parts as well as for the whole of the individual. In the individual the normal development of the muscles demands most of the power of growth, since in the adult they constitute 43 per cent of the body weight. After the musculature the skeleton demands most of the power of growth, it forming 17.5 per cent of the body weight in the adult. And in the bones the growth discs grow fastest, since they have to procure the whole of the length in reason to the bones. Therefore in feebleness of growth it is rational to expect growth changes first in the muscles, next in the growth discs, and last in the diaphyses of the long bone.

The symptoms of feebleness of growth have been ascertained by comparing the growth of children of the same parents with regard to injurious agents they have sustained, and by doing so in a large number of families. Only such phenomena as conformed to the law mentioned were reckoned among those of feebleness of growth. Thus three degrees of growth have been established:

1. The slight degree with mere muscle weakness is characterized by the muscle quartet: weak feet, prominent abdomen, round shoulders, blue bands and feet. It will lead to overgrowth in adolescence.

2. The severe degree, known as rickets, is characterized by severe muscle weakness. The skeleton lag behind the normal in growth, and all growth cartilage are affected.

3. The moderate degree is represented by the knock-kneed child with muscle weakness, which is neither too tall nor too small.

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e ble

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p ofess o of our d v to a mealmo t m l
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bld wh c n t th th ped d p rtm nt w
c mp ed w th t b th d te s It pp d
th t k ty bld wh ch w io d m gm
no m l chld n f th m p t wa l
d t g h d by a h to y of s m v bn
f f e t had t d f r ex mple f e t s
d sea autr t e d tu b of th chld f r
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(pl t p æ) f f g f the moth r d g
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gph nome m g th f fe bl m t

The enfeeblement of the body resulting from diseases and injurious agents generally has always received due consideration from the profession. However it has not been realized that enfeeblement of the growing body implies enfeeblement of all functions, inclusive of the essential function of growth. The result is that the symptoms of feebleness of growth have not been recognized and pass under inappropriate names usually taken from the Greek and Latin.

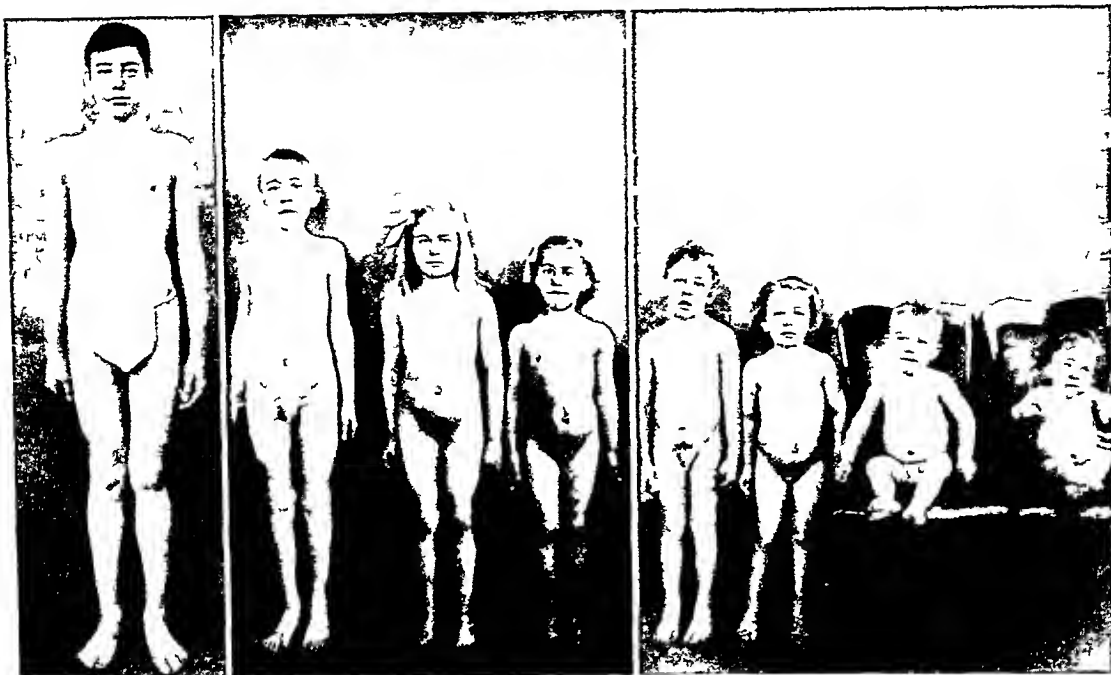


Fig 7 Family F For explanation see Table IV

On this basis it is easy to complete Hueter-Volkmann's pressure rule. If in Figure 9 the dotted line represents a normal tibia, the three sloping lines represent the relative position which the growth discs of these three types occupy. Enfeebled bone, indeed, behaves in conformity with Hueter-Volkmann's pressure rule where pressure increases, growth decreases, and reversely, where pressure de-

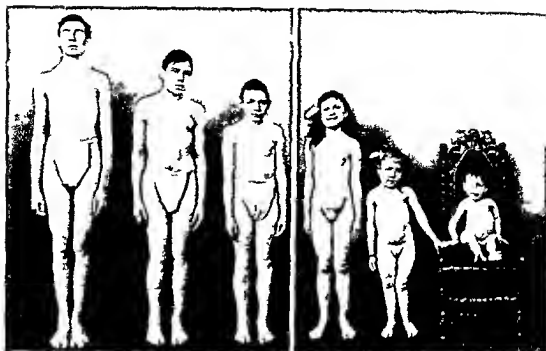
creases, growth increases. But it should be observed first that only in the moderate degree of feebleness of growth there may be both a real increase and a real decrease with regard to the normal, whereas in the severe degree even the side of the less pressure lags behind the normal, in the slight degree even the side of the greater pressure exceeds the normal, and moreover that the difference between the two

TABLE IV—FAMILY F, FEBRUARY, 1917 (FIG 7)

Child	Age	Height— meters	Difference of height with normal of Quetelet %	Weight— kg	Difference of weight with normal of Quetelet %	Began to walk at age
First	17 yrs 1 mo	1.641	+ 2.7	52.5	- 1.3	1 yr 6 mos
Second*	14 yrs 7 mos	1.481	- 0.75	38	- 2.06	2 yrs 6 mos
Third	11 yrs 10 mos	1.327	- 2.85	28.6	- 2.39	2 yrs
Fourth	9 yrs 11 mos	1.187	- 4.6	22.4	- 3.9	2 yrs
Fifth	7 yrs 10 mos	1.09	- 3.77	18.0	- 4.26	2 yrs
Sixth	6 yrs 2 mos	1.055	- 7.62	18.2	+ 4.0	2 yrs
Seventh	5 yrs 1 mo	0.963	- 1.0	15.4	- 5.8	2 yrs
Eighth	2 yrs 11 mos	0.758	- 11.6	10.2	- 17.0	Cannot stand
Ninth	1 yr 5 mos	0.631	- 14.4	6.3	- 38.0	Cannot stand

Height of father: 1.75 meters of mother: 1.518 meters

*Photograph could not be obtained. Child has knock knees—distance between ankles: 5.5 centimeters



F 6 Family II F repl t se T it III

The rachitic type usually becomes a knock-kneed child when 4 or 5 years old. The severe degree of the first years indeed usually lags behind in growth throughout life, whereas the slight degree outgrows its strength mainly during adolescence. Here again there is a parallelism of the growth changes with the rapidity of growth. It is well known that in the first year the child adds 40 per cent to its length, about 13 per cent in the second, 9.7 per cent, 6.5 per cent, 5 per cent in the succeeding years, and 2.5 per cent in the six

teenth. And it stands to reason that a child being born with a certain degree of enfeeblement (necessarily inclusive of enfeeblement of the power of growth) will lag behind the normal requirements of growth less as they go on decreasing in the course of years. Hence it is not only the parts in these three types which are affected in a degree proportional to the rapidity of their growth, but the whole body. And this strongly corroborates the view that the rickety, the knock-kneed child and the overgrown represent three degrees of enfeeblement.

TABLE III—FAMILY II JANUARY 7 1917 (FIG. 6)

Child	Age	Height in cm	Difference from normal 1 Q	Weight in kg	Difference from normal 1 Q	Remarks
First	7 yrs m	75	+ 9.6	56.7	+ 4.8	
Second	5 yrs 4 m	49	+ 8	46	+ 6	
Third	yrs mo	36.5	+ 5	37	+ 3	
Fourth	yr m	6	+ 5.8	6.7	+ 5.5	
Fifth	7 yrs 6 mos	93	- 4	56	- 5.4	5
Sixth	5 yrs m	77.5	- 4.8	4	- 9.4	Does not walk

H b of her me h h f mo her m

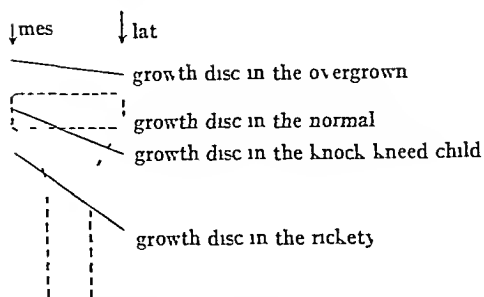


Fig 9 Position of upper growth disc of tibia in the enfeebled as compared with the normal (schematic)

normal, is to be considered as the outcome of the restoration of the normal reserve power of growth

It needs no comment that the uninterrupted lines obtained in Figure 9 are parts of as many physiological curves which have an ascending as well as a descending portion. We have represented them in Figure 10 by completing them by dotted lines. In this figure pressure has been noted on the horizontal, growth on the vertical line. In curve I of normal growth the reserve power of growth has been represented by a rise of the curve even after the pressure exceeds the normal, "n". In slight feebleness of growth (curve II) there is no reserve power of growth; any exertion exceeding the normal tends to the development of knock-knees in the overgrown. The overgrown errand boy, for example, will develop knock-knees, especially if he has to carry heavy parcels. This phenomenon is indicative of *enhanced fatigability* of the growth discs near the knee. On the other hand, the fact that the top of curve II rises higher than normally, indicates their *enhanced irritability*. Those two properties of enfeebled bone substance are still more pronounced in curve III, which represents severe feebleness of growth. It ascends and descends steeper than curve II and turns round to still less pressure. These curves lay no claim to mathematical exactitude. Yet they may tend to show that Hueter-Volkman's pressure rule, which is represented by *a-b*, is concerned with only one out of many possibilities. Moreover, they may show the characteristic properties of enfeebled tissues, viz. *enhanced irritability* and *enhanced fatigability*.

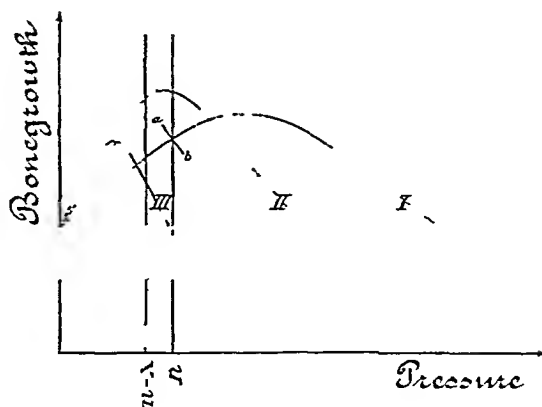


Fig 10

Very instructive with regard to the growth changes in severe feebleness of growth is the X-ray of the rachitic hand (Fig 11). In the first place it is smaller than the normal hand as is the rachitic body as a whole. When enlarged to the size of the normal hand of the same age (Fig 12) we are struck by the fact that the metacarpals are shortened far more than the fingers. And among the metacarpals the first and fifth are still more retarded than the others. It will be realized that the proximal bones of the hand are exposed to greater muscle forces than the distal ones, and the first and fifth metacarpals to extra stresses from thenar and hypothenar. So the bones of the rachitic hand show a retardation of growth which is proportional to the pressure they have to resist, as is represented in the descending portion of curve III in Figure 10.

But there is more: the bone centers in the epiphyses of the metacarpals and in the carpal bones are smaller than normal even in the enlarged hand of Figure 12. This means that the transition of cartilage into bone is retarded even more than the growth of the bones as a whole. And if this transition into bone is called *differentiation*, we may say in severe feebleness of growth differentiation shows extra retardation.

It lies beyond the limits of this address to deal with all phenomena of feebleness of growth. Yet the thickening of the growth cartilages, observed in the severe form, which more than any symptom of rachitis has drawn the attention of the profession, demands men-

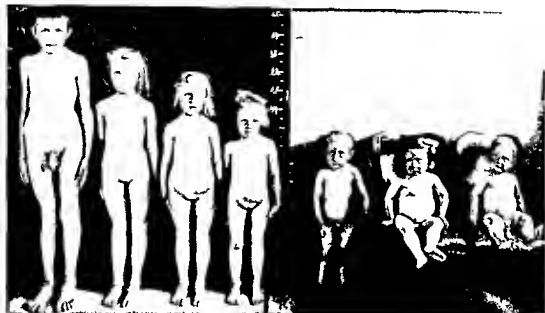


Fig 8 Family of H. F. Expl. t. se. Tbl. V.

sides becomes less in proportion as the degree of enfeeblement approaches the normal.

In the normal subject on the contrary a moderate increase of functional pressure is associated with an increase of growth the normal child as a rule starts its first steps with bow legs. The fact that these legs grow straight signifies that the mesial side of the

greater pressure grows more quickly than the lateral side. Normal bone substance disposes of a certain reserve power of growth to an increase of pressure. And the spontaneous straightening of slight knock knees in children which is observed when causes for temporary enfeeblement disappear and more generally when the bodily condition comes nearer the

TABLE V.—FAMILY OF H. F. JUNE 4 1917 (FIG 8)

Child	Age	Height inches	Weight pounds	Arm span	Diastasis of ribs	Other	Remarks
Girl	3 yrs m	5	15.8	35	+	8	4 mos
Girl	5 yrs m	3	76	47	—	45	y 6 m
Girl	—	—	—	—	—	—	—
Girl	—	—	—	—	—	—	—
Girl	7 yrs 9 m	9	55.8	—	+	3	yr 6 mos
Girl	6 yrs 4 m	75	45	67	+	—	y 6 m
Girl	5 y	7	8	5	—	7	3 yr
Girl	3 y 3 m	775	8	5	—	3	3 y
Girl	yr 9 m	735	43	7	—	9	D t w lk

Height
inches
Weight
pounds
Arm
span
Diastasis
of ribs
Other
Remarks

Height
inches

Weight
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Arm
span

Diastasis
of ribs

Other

Remarks

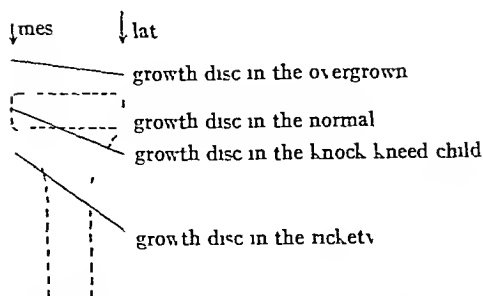


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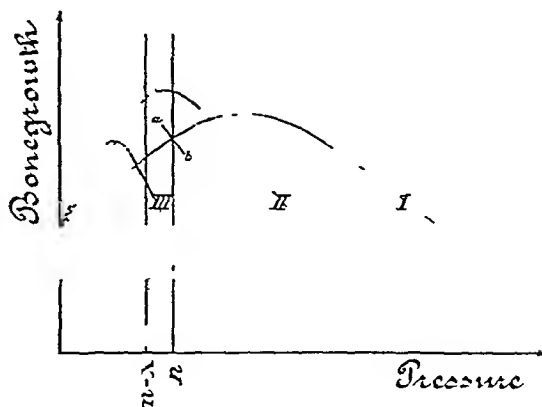


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Fig. C H F 3 rs 8 m th ld

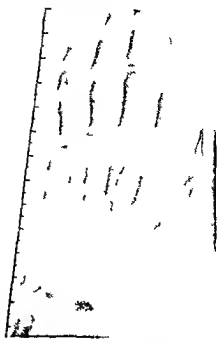


Fig. W H F 3 rs 5 m th ld

tion. The normal growth cartilage presents side by side three areas: one of division of cartilage cells, one of enlargement of cartilage cells, one of differentiation. Now the microscopic examination of a number of growth discs taken from children who had died at the same age but from different causes has furnished grounds for the assumption that in feebleness of growth the three processes are retarded respectively arrested in reverse order: i.e. differentiation first and most severely, cell enlargement next, cell division last and least severely. All the symptoms these growth cartilages presented thus seemed to find an explanation in the assumption that in this reverse order they are processes of successively decreasing rapidity of growth. Hence we are forced to ascribe the thickening of the growth cartilages in rickets to an extra retardation of differentiation as is more directly noticeable in the short bones. In other words in severe feebleness of growth differentiation behaves as a process of more rapid growth than cell division and cell enlargement.

Summarizing we recognize four grounds for the assumption that the rachitic the knock-

kneed child and the overgrown are to be considered as three degrees of enfeeblement inclusive of feebleness of growth: viz. (1) the fact that they may be brought about by any injurious agent; (2) that in these conditions the parts of the body are affected in a degree which is proportional to the rapidity of their growth; (3) that their body as a whole is equally subject to the law of the vulnerability of rapidly growing cell groups; (4) that bone growth in these conditions shows the properties characteristic of enfeeblement: viz. enhanced irritability and enhanced fatigability.

T m d not llo met sket h n d t l th r
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aspect in these than in normal individuals. Poliomyelitis takes its victims almost exclusively from among the enfeebled. And the narrow limits of tolerance to the anæsthetic these patients show during an operation are in agreement with the enhanced irritability and fatigability of their nerves. In proportion as the muscle weakness is greater, i.e., in moderate feebleness more than in the slight degree, the abdominal wall will perform less well its function as a suction and force pump for the circulation of the blood in the organs for digestion, and abdominal affections will more frequently require treatment of physician and surgeon.

Thus by the study of the quantitative growth changes in the locomotor apparatus, orthopedics has drawn the picture of the *feeble constitution*. This constitution is nothing but a quantitative deviation from the normal life processes. It presents itself in three degrees with all imaginable transitions between total lack of the power to grow, or even death, and normal strength. It develops from normal life according to simple laws and rules.

In medical literature many a type of constitution has been pictured in which phenomena of enfeeblement play a role, such as status hypoplasticus (Rokitanski, Bartel), asthenia (Stiller), status thymicolymphaticus (Paltz), exudative diathesis (Czerny), insufficiency of the fibrous tissue (Bier), hypotony (Tandler), lymphatism (Stoerk). The large number of these conditions proves on the one hand how great the need is of a proper constitutional insight, and on the other hand that the grounds for unity in this insight fail. In none of these pictures has the development of the phenomena been traced in conformity with biological laws or rules. In none are grounds brought forward that will enable one to discriminate between quantitative and qualitative changes, urgent though this be. The quantitative changes, indeed, do not necessarily occur in the ancestors, they are not necessarily hereditary, the qualitative changes, on the contrary, are. They obey Mendel's laws. And, what is most important, the quantitative changes may often be forestalled, the qualitative cannot. Therefore it will be useful to learn whether the phenomena designated by these various constitution types, obey the law and the rules to which feebleness of growth is subject. A beginning has been made in Leiden. From our study it seems probable that different symptoms of Czerny's exudative diathesis are the outcome of an enfeeblement of skin and mucous membranes, that the nervous system of the enfeebled enhances the chances of hypertony and hypotony, that of Paltz's status thymicolymphaticus the excessive length growth, the narrow aorta, the persistent thymus, the enhanced liability to suicide are intrinsic of the slight degree of feebleness of growth.

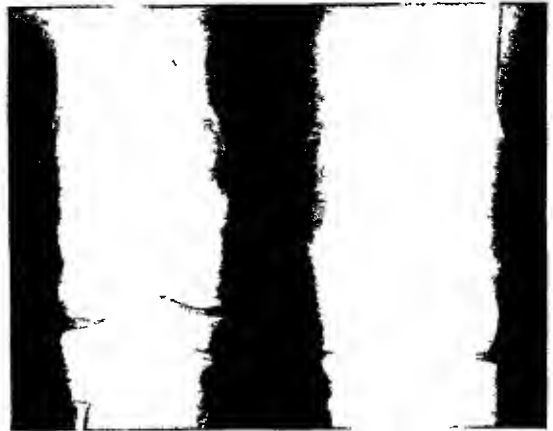


Fig 13 Roentgenogram showing lengthened metaphyses

The obstetrician, the pediatrician, the physician, the surgeon, the ear specialist, the neurological and psychiatric specialist who by a glance at the locomotor apparatus of their patients will learn to estimate the degree of their patient's weakness will derive valuable data from this estimation, sometimes enabling them to determine the cause, often the nature, and even the method of treatment of the condition they are to deal with. The laws and rules which prevail in the development of the locomotor apparatus, may serve them as working hypotheses for the solution of the more intricate problems the internal organs present. This is a service which orthopedics has rendered to the medical sciences in return for what she owes to them.

Extra retardation of differentiation, as observed in severe feebleness of growth, presents itself in other forms of dwarf growth, regardless of the cause provided there be no complete arrest of growth, e.g., in myxœdema and achondroplasia. It is one of the forms of dissociation of the processes of bone growth affecting the whole skeletal system symmetrically, a systemic dissociation. In Ollier's dyschondroplasia each of the various processes of bone growth may be seen to dissociate itself from the other processes of growth, locally each giving rise to the development of a characteristic phenomenon, for example enchondromata, exostoses, lengthened metaphyses (Fig 13). In dyschondroplasia the cause is

probably a local one and is connected with the blood vessels. Hence dissociation is a familiar occurrence in the life of the bone substance. In preformed bone the behavior of inorganic salts with regard to that of the colloid substance as described in the early part of this paper may be considered as a form of dissociation under the influence of variations of functional stresses. And even the brittleness of bones living under enhanced hydrostatic pressure as in edematous conditions is possibly the outcome of the same process.

The application of the laws of growth together with mechanical data constitutes the *biomechanical method of research* characteristic of orthopedics. Besides designating the phenomena of enfeeblement and creating the picture of the feeble constitution in three degrees it has enabled us to determine the nature of a number of congenital malformations to arrange them in chronological order and *per exclusionem* to designate smallness of the amnion as their cause.

Thus orthopedics has made a beginning in creating order in a large domain of teratology but much important work remains to be done.

In a most interesting study published in the *Chloride* of the law of the variability of rapidly growing cells by the influence of the environment, it is shown that the development of the embryo is affected by the environment in a manner which is not yet understood.

Moreover the laws of growth serve as a guide to treatment. They make us understand why, for example, lateral curvature is liable to develop in the first years of life especially in weak children and why in that period of rapid growth the condition is amenable to improvement whereas in the tenth year when growth is ten times as slow as in the first or in the sixteenth year when growth is sixteen times as slow unduly powerful measures are required for improvement.

Likewise we can predict what changes are apt to develop in hip joints with congenital incongruity whether coxa plana, coxa valga and slipping epiphysis or malum coxae.

The most important conclusion which the laws of growth render justifiable is that the rapidly increasing number of overgrown adolescents in different nations bespeaks enfeeblement. And with a view to the future of such nations it is urgent that the causes of this enfeeblement be traced and forestalled.

But for the law of the vulnerability of rapidly growing cells it might be imagined that only such obnoxious agents will lead to enfeeblement of the children as enfeeble or exhaust the parents in like degree. However in this regard it has been observed that the fetus is affected far more seriously than is the mother by fatigue during pregnancy. The mother shows no change whatever after delivery whereas the child affected during the whole period of its development by the same injurious agent appears to have sustained a considerable reduction in its power to grow.

The law of the vulnerability of rapidly growing cells thus introduces a new factor in estimating the effect of injurious agents which act on prospective mothers, a factor which also bears on prospective fathers. Indeed it should be remembered that in the adult male the sex glands are in more active cell division than are all other organs, the latter being largely confined to the maintenance of metabolic balance. This has become evident from the sensitiveness of these glands to X-rays and possibly also from the inordinately rapid growth of tumors of the testicles. In this connection it is of importance to mention that Levaditi observed that his neurovaccine produced pustules by preference in the ovaries and testicles of test animals and in areas of skin where by pulling out the hair active cell division had been evoked. In short it is beyond doubt that in the male sex gland and probably in less degree also in the female germ glands the normally active cell division renders these organs more vulnerable than the other parts of the body. And it should be kept in mind that injurious influences which have no noticeable ill effect on any of the organs of the adult may imperceptibly injure the sex glands and enfeeble the inscrutable potentiality of the germ cell.

At the risk of seeming presumptuous I venture to state that just as bacteriology and

parasitology were destined to reduce disease by which mankind was decimated, so orthopedics seems to be destined to teach the methods of forestalling the enfeeblement of our race. At all events the aforesaid may suffice to show that orthopedics has to a certain extent risen from a stage of empiricism into that of a science it being, at least partly, founded on laws and rules.

If it is true that a science attains social importance as soon as it becomes beneficial to many, the above may have contributed to establish such importance of orthopedics. So far, moreover, this has been done on a large scale by the practice of orthopedics, which culminated during the great war, when 30,000 beds were occupied in England by orthopedic patients. The recognition of the true nature of a number of morbid conditions and the application of most ingenious modes of treatment meant enhancement of efficiency to thousands and thousands both in peace and in wartime. The share the Liverpool School of Orthopedics had in this work, is well known. And it must here be stated that hardly any orthopedic condition can be named in which the two great orthopedic leaders of this school have not made their contribution by adding manipulations, operations, or appliances to the armamentarium of the orthopedist.

Because of the humanitarian spirit which has developed during the twentieth century, orthopedics has extended its social task by striving for the eradication of crippleddom. Through the great help of charitable lay people, a wide social scheme of prevention, location, treatment, after-care, education, vocational training and placement service has developed, the beneficent influence of which is felt throughout the world. In this service wealth, science, technical skill, and self-sacrifice have joined hands. And in the annals of mankind it may be noted with golden letters that to the English speaking nations the honor is due of having given most in voluntary aid and charitable work.

Thus orthopedics by harmonious co-operation of charity and science, is leading the way to greater bodily efficiency and a stronger

posterity to all those who are willing to obey the laws of nature.

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HISTOGENESIS AND TENDENCY TO BILATERALITY OF PAPILLARY
OVARIAN CYSTS¹

RAY B M CARTA M D R T R ID C L
F H S T Y Th I F und

EVILLY embryological and histological structure in the ovary except the lymphatic vessels and the nerves has been considered hypothetically to be the origin of papillary cysts (1 to 9 11 12 14 to 24) The cysts also have been said to arise from misplaced remnants of tubal epithelioma (10 13 22) (which is derived from the same primordial germinal epithelium as that of the surface of the ovary) Many of the hypotheses however are no longer tenable and in general modern authorities accept one or two of the three that follow (1) that they develop from the germinal or surface ovarian epithelium which includes its invaginations tubules and small cortical cysts (2) that they develop from the graafian follicles or (3) that they develop from the rest of the ovary (wolffian tubules)

Both ovaries of a given subject are often observed in the pathological laboratory the one bearing a papillary ovarian cyst and the other appearing grossly normal. In such cases the surgeon has removed both ovaries because of his knowledge of the danger to the normal ovary.

In an attempt to explain this tendency to bilateral involvement of the ovaries authors have mentioned actual contact of the two ovaries implantation metastasis through the retroperitoneal lymph spaces and independent development of the condition in the two ovaries from intrinsic structures. The last explanation seems most plausible because if the ovarian tumor is intracystic that is has not broken or ruptured through its outer cystic wall actual contact of the two ovaries or implantation could not explain the bilateral involvement. In regard to metastasis from one ovary to the other by means of the retroperitoneal lymph spaces it seems logical to conclude that this rarely occurs because other evidences of metastasis by the lymphatics are uncommon in this type of tumor.

Thus the premise was taken that the tumors when bilateral develop independently of one another and a study was undertaken to determine the incidence of occurrence and the form of any potentially pathological structures or beginning ovarian tumors which could be found in grossly normal ovaries which had been removed at operation to either with intracystic papillary ovarian cysts of the opposite ovaries. Eighteen suitable specimens were studied. For a control group 50 cases were selected at necropsy and at operation in which both ovaries were grossly normal one ovary was studied in each case. The average age of the patients of both groups was between 45 and 50 years.

Each ovary was cut into three blocks of equal size and from each block three microscopic sections were made at equidistant levels thus affording a representative histological picture of the entire organ. If structures of interest were found serial sections were then made.

We shall consider the two groups of cases together because of the morphological similarity of structure. A few important differences in the two groups will also be considered.

RESULTS

The germinal or surface epithelium and its structures were complex. The usual type of surface epithelium was cuboidal but in ovaries at the age of the patients from whom the tissue studied was derived superficial and deep crypts or indentations are often observed in the deep indentations particularly the epithelium often became columnar in type (Fig. 1). In the vicinity of these indentations (although occasionally isolated) tubules could be observed which were lined by epithelium similar to that of the indentation and when traced by serial section it was noted that the more superficially placed the tubule the more likely it was to be connected with an indentation.

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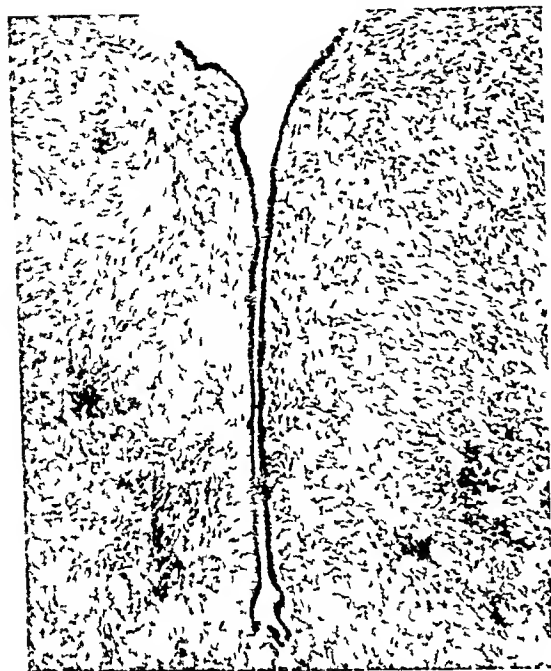


Fig 1 A deep surface indentation lined by high columnar epithelium

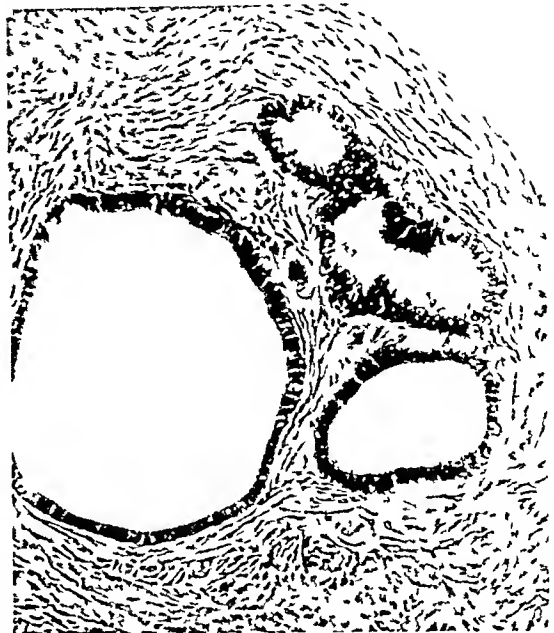


Fig 2 A small group of epithelial structures in the cortex lined by high columnar epithelium; the surface epithelium is missing, probably the result of trauma ($\times 100$)

The germinal epithelial structures of most interest were the microscopic cystic structures commonly found in the cortex (Figs 2 and 3). They were single or in groups, with a varying number of tubules. Their lining might be of a columnar, ciliated type, similar to that observed in papillary ovarian cysts. However, a part or all of the epithelium of these structures might be of a cuboidal or flat type, particularly in the larger cysts. By serial section these structures were rarely found to have any connection with an indentation and maintained approximately their same relative position in the cortex when traced through their entire course, which varied from 50 to 1,500 microns or more. The tubules of the group often anastomosed with the microscopic cystic structures or dilated into cysts. Not rarely a cystic structure was found which contained material that gave a positive reaction for mucin, and degenerative changes were not uncommon, as exemplified by deposits of calcium (psammoma bodies) replacing the small structures. A small cystic structure often was found just beneath the epithelial covering

of the ovary, it appeared as a minute vesicle, and in many instances was called a subserous cyst.

It would appear, from these observations, that the structures had as their progenitors the epithelial tubules which had pinched or



Fig 3 A group of cortical epithelial structures showing a tubule which communicated for a short distance with a small microscopic cyst ($\times 38$)

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F II S Th M F d

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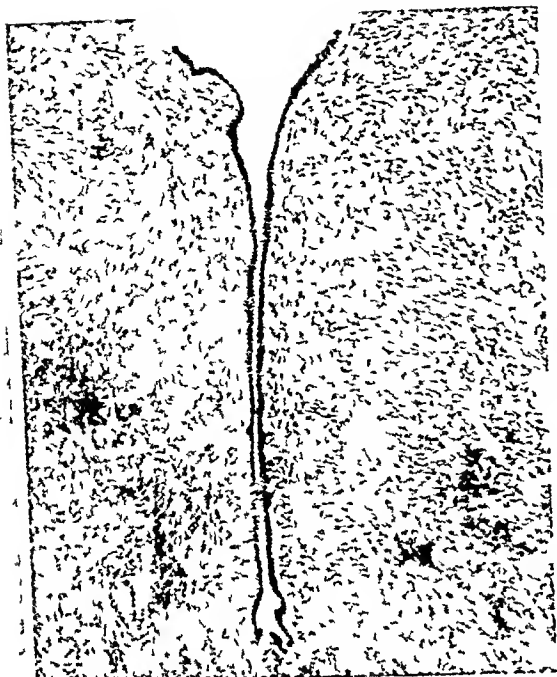


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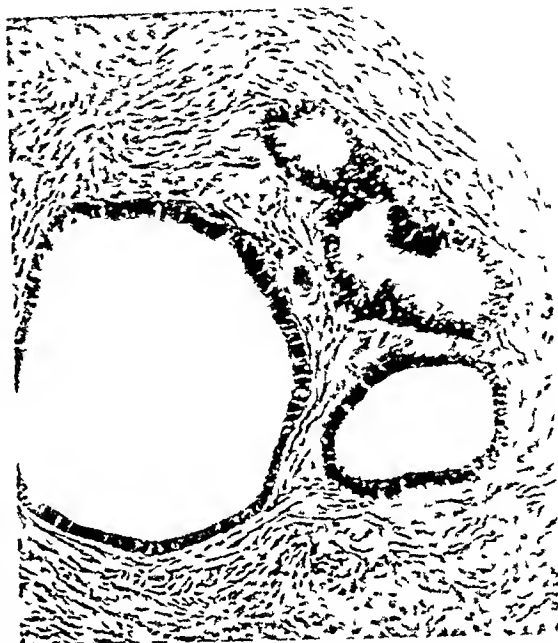


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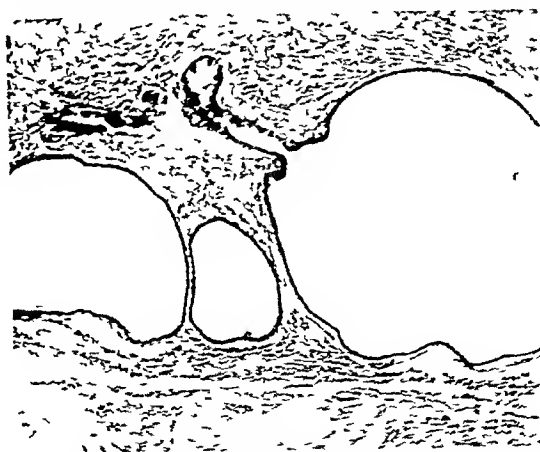


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RAY B M CARTY M D R M C
F l w S Th I F d 10

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Fig 5 A beginning intracystic papillary ovarian cyst in the medulla of a grossly normal ovary, the opposite ovary was replaced by a multilocular intracystic papillary cyst ($\times 70$)

grossly normal ovaries which were removed with intracystic papillary ovarian cysts of the opposite ovary, two ovaries contained small, round, cortical, cystic structures lined by non-ciliated columnar epithelium. Both of these structures suggested origin from graafian follicles, because the surrounding cellular tissue contained a few cells which appeared as theca lutein cells.

5 The rete of the ovary was found in 78.9 per cent of the group of grossly normal ovaries removed with an intracystic papillary cyst of the opposite ovary and in 86 per cent of the normal control group. Usually they occurred as two or three inconspicuous groups of tubules near the center of the medulla in the third of the ovary nearest the hilum, although in three specimens the tubules near the hilum were numerous, giving an adenomatous appearance. An instance was not found to suggest a connection between the rete of the ovary and the cortical epithelial structures. The epithelial lining of the rete of the ovary was usually of a columnar type with cilia, and from the



Fig 6 Small superficial papilloma of the ovary. The high columnar epithelial covering with the many indentations and the small cystic structure communicating with one of the indentations may be noted ($\times 20$)

appearance one would immediately suspect them of being the parent structures of the papillary ovarian cyst. However, only a few cases have been reported in support of this hypothesis of origin, which will stand scientific criticism.

SUMMARY

A review of the observations is as follows: the small, cortical, epithelial cystic structures were found in 100 per cent of the grossly normal ovaries which were removed with intracystic papillary ovarian cysts of the opposite ovary, whereas in the normal control group the structures were found in only 64 per cent of the cases. These structures are undoubtedly of germinal epithelial origin. Two of the grossly normal ovaries which had been removed with an intracystic papillary cyst of the opposite ovary showed definite beginning tumors: an early carcinoma, and a papillary ovarian cyst. Both appeared to have originated from the small, cortical epithelial cystic structures despite the fact that one (the beginning papillary ovarian cyst) was situated in the medulla. The superficial papillomata were found about twice as frequently in grossly normal ovaries which had been removed with intracystic papillary ovarian cysts of the opposite ovary, as in the ovaries from normal controls. From the microscopic appearance it is apparent that these structures are closely related to the

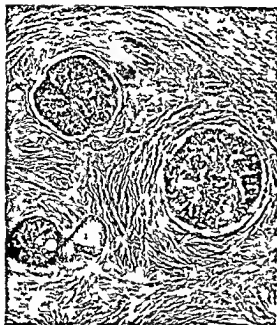


Fig 4. Early medullary development of the ovary. The image shows a cross-section of an ovary with several large, circular follicles. The surrounding tissue is dense and granular, indicating early medullary development.

budded off from the surface indentations of the germinal epithelium or had resulted from incomplete atrophy of the germinal epithelial structures in the embryonic ovary (7).

In comparing the epithelial structures as found in the two groups of cases certain significant differences were noted.

1. In the grossly normal ovaries each of which was one of a pair removed because there was an intracystic papillary cyst in the opposite ovary, these cystic structures were usually abundant and found in all cases. On the other hand, in the normal control group these structures were usually not so abundant and were observed in only 64 per cent of the cases.

2. Definitely beginning tumors were found in 2 of the grossly normal ovaries which had been removed because there were papillary cysts in the opposite ovaries. One tumor an early carcinoma (Fig 4) consisted of a group of solid epithelial structures found in the cortex and by serial section one of these structures was seen to merge into an epithelial tubule lined by goblet cells. Many groups of the small cortical epithelial cystic structures

were found in this ovary and it is from these that the carcinoma undoubtedly took its origin. The cells undergo carcinoma hyperplasia. The second specimen revealed three small cystic cavities in the medulla of the ovary. Their walls were rou hened due to papillary ingrowths as was shown by microscopic examination (Fig 5). The lining of these small cystic cavities was for the most part of a high columnar ciliated type of epithelium similar to that observed in the several small groups of epithelial cystic structures in the cortex. These cystic cavities undoubtedly were beginnings of intracystic papillary ovarian cysts which developed from some deeply placed cortical epithelial cystic structures and which as they grew expanded in the direction of least resistance. It is noteworthy that the rete of the ovary was found as an inconspicuous structure in the medulla near the hilum and that it did not show any connection with the beginning intracystic papillary ovarian cyst.

3. Superficial papillomata were observed in 8 per cent of the specimens in the control group and in 15.7 per cent of the grossly normal ovaries which were found associated with an intracystic papillary ovarian cyst of the opposite ovary. Their appearance was characteristic and was in contrast to the surrounding cuboidal surface epithelium. All except one was covered at least in part by high columnar non ciliated epithelium similar to that of the small cortical epithelial cystic structures. In several there were indentations of the surface epithelium into the stroma and in one specimen (Fig 6) an indentation communicated with a small cystic structure lined by columnar epithelium. This is significant in that the opinion gained from the microscopic data in the two groups of cases corroborates that of Williams, Gottschalk, Hofstetter and others that there is a definite relationship between the superficial papilloma and the papillary ovarian cyst.

4. It has been proved that a papillary ovarian cyst may arise from a graafian follicle but in this study nothing to suggest this was found and in only 2 instances could a possible relationship with the small cortical epithelial cystic structures be cited. In the group of

CLINICAL SURGERY

FROM THE DEPARTMENT OF SURGERY, TEMPLE UNIVERSITY

A TECHNIQUE FOR VAGINAL HYSTERECTOMY

W WAYNE BABCOCK, M D, F A C S, PHILADELPHIA

IT is my purpose to discuss the vaginal approach in operating upon the pelvic organs, as I believe that this route is not receiving the attention that it deserves.

The posterior uterine cul-de-sac is separated from the vagina by tissues only a few millimeters in thickness. This thin partition is easily punctured or divided, thus giving the quickest and probably the safest access to the pelvic cavity in women. With the patient in the Trendelenburg position and with the use of appropriate trowels and other retractors, the pelvic cavity may be explored by direct vision. The ovaries and tubes or the fundus uteri may be pulled down into the vagina, examined, and treated radically or conservatively. Pedunculated or interstitial tumors may be removed from the uterus, ovarian cysts evacuated, delivered, and removed, and large solid tumors morcellated and extirpated. Not infrequently the vermiform appendix may be seen and even removed. For many years, we have used this approach in operating for ectopic pregnancy. As the cul-de-sac is freely opened, there is a gush of blood, the finger locates the diseased tube, which is seized, pulled into the vagina by sponge forceps, and either clamped or ligated. A gauze pack is placed in through the opening in the cul-de-sac, and the operation is over. The time required has been less than that required to sew up an abdominal wound. As a diagnostic measure the cul-de-sac incision should be considered.

As for vaginal hysterectomy, while it has been enthusiastically praised by a small group, it has never become widely popular. Many abdominal surgeons never use it. In some of the surgical centers it is hardly ever mentioned. Is it because it is not a safe operation for the patient, or because it may impose operative difficulties on the surgeon? Or is it that we follow the operation to which we become habituated, and find it inconvenient to select from a variety of methods when a single routine one will serve the purpose?

Surely, the vaginal route is not avoided to protect the patient. I doubt if as low a mortality can be obtained by any abdominal method of hysterectomy. The statement of Pryor,¹ in 1903, that vaginal hysterectomy has no mortality, while, of course, not absolutely accurate, indicates a not unusual experience, and may be compared with the very low mortality attained with this operation by Joseph Price and J W Kennedy. In a personal experience of over 300 vaginal hysterectomies, over 50 per cent of which were done for fibromyomata, there have been no deaths, when the operation was done for non-malignant disease, since 1914. During this period, about 200 vaginal hysterectomies have been done with the technique to be described. In recent years especially, the continued low mortality and morbidity have caused us to turn more and more to the vaginal extirpation. In a series of 107 cases before 1914, during a period when insulin was unknown, and when clamps or mass ligation often with vaginal closure were used, there were 4 deaths, and a number of postoperative hæmorrhages or localized pelvic infections occurred. The present rather simple technique has largely eliminated these dangers.

I feel very sure, considering the types of patients selected for the vaginal operation, that a mortality of less than one-half of one per cent would not have obtained had I resorted to supra-vaginal hysterectomy, or especially to complete abdominal hysterectomy. The patients were for the most part elderly, a large number were obese, not a few were markedly anæmic from hæmorrhages.

The chief indications for the operation have been hæmorrhage and tumor. Over 80 per cent of the fibroid tumors treated by hysterectomy were removed through the vagina. Certain of the tumors reached to or slightly above, the navel. The exertion expended in the morcellation of certain of these large, hard fibroids is consider-

¹Text Book of Gynecology

papillary ovarian cysts. In this series of cases very little evidence was obtained to indicate that the graafian follicles or the rete of the ovary are frequent sources of origin of the papillary ovarian cyst.

Thus it may be stated (1) that most papillary ovarian cysts probably develop from the small germinal epithelial cystic structures found in the cortex of the normal ovary and (2) that the grossly normal ovary which is found in association with an intracystic papillary ovarian cyst of the opposite ovary is a potential danger and should always be removed age permitting.

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Fig 4



Fig 5

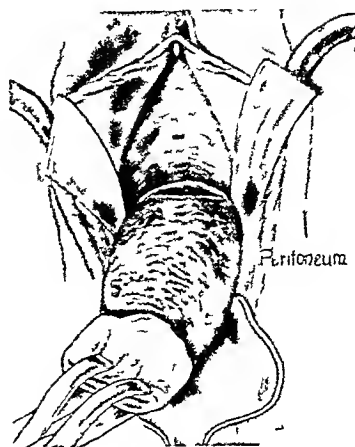


Fig 6

Fig 4. The anterolateral margins of the vaginal incision are retracted by a narrow trowel, thus exposing the lower branch of the uterine artery which is ligated and divided first upon one side and then the other.

Fig 5. Under traction the uterus starts to descend and with a few snips of the scissors laterally the main trunks of the uterine vessels come into view and are also individually ligated, divided, and the pedicles retracted by the edge of the trowel. Posteriorly as the uterosacral ligaments are divided the posterior cul de sac is opened and a narrow pad with attached tape may be introduced into the pelvis. The uterosacral ligaments may or may not be ligated.

Fig 6. Unless fixed by size or adhesions the uterus may now be partially withdrawn from the vagina and the lower loops of the ovarian vessels are exposed, ligated, and divided close to the uterus. At this stage the anterior cul-de-sac is often opened, but no special attempt is made to do this or to separate the bladder from the uterus in the midline. By progressive liberation and ligation laterally, keeping close to the uterus the peritoneum at the anterolateral face of the uterus will be entered without difficulty and by proper retraction by the trowel the bladder and ureters will be held out of harm's way.

with very poor myocardium, it seemed better to face the very definite operative difficulties of the vaginal route, than the forlorn chance of recovery from a complete abdominal hysterectomy.

In the entire series, a procidentia was present in over 22 patients. In 2 of them, there was a secondary prolapsus of the vaginal walls after the hysterectomy. Of course, hysterectomy alone is an insufficient operation for a prolapsed uterus. No vaginal hernia in a patient without pre-operative prolapsus has been observed in our series.

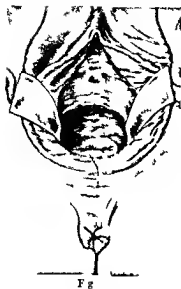
A perineorrhaphy of the submucous type was associated with the hysterectomy in 46 cases. In about 35 patients, the appendix was also examined and removed through the vagina.

The treatment of the appendages has varied. As a rule, the tubes were removed even though not diseased to prevent a postoperative mucous sinus of the vaginal vault. In patients before the menopause, an attempt was made to save at least a part of one ovary.

TECHNIQUE

The patient is shaved, the vagina is thoroughly cleansed, and a folded sterile towel or thick pad is fastened by towel clip over the anus. With the

patient in the high lithotomy-Trendelenburg position, a weighted posterior vaginal speculum is introduced, the cervix is dilated and the uterine cavity is packed with a narrow strip of gauze wet with 3.5 per cent tincture of iodine. If intra-uterine sepsis is present, the intra-uterine packing is carefully wrung out of a saturated solution of zinc chloride, and the vagina is then cleansed with tincture of iodine. The cervix is firmly grasped with strong volsellum forceps, pulled down, and encircled at the cervicovaginal fold, by a scalpel. The cervix is then pulled strongly downward and to the right, while the left upper margin of the incision and bladder are retracted and lifted upward by the edge of a narrow trowel. With a few touches of the scalpel or scissors, the lower loop of the uterine vessels is exposed and ligated close to the cervix by No. 1 plain catgut carried by a small curved needle. As the vessels are divided medial to the ligature and the pedicle and parametrium are pushed up and lateral by the edge of the trowel, the uterus begins to descend under traction. Pulling the cervix down and to the left, with a few snips of the scissors, the right lower uterine vessels are also exposed, ligated, and then divided close to the cervix. With traction somewhat forward, first to the left and then to the right,



Fg 3

Fg 3 Vaginal hysterectomy. Ap. l. m. ry p. t. my. ly. m. h. g. n. t. dis. wh. th. g. l. h. y. t. ect. my. d. wh. h. ly. ext. th. l. wh. h. ry. d. ted. by. f. m. h. g. n. t. dis. wh. th. g. l. h. y. t. ect. my. d. th. d. t. t. l. es. oc. as. lly. des. bl. d. t. b. ta. w. th. g. l. h. y. t. ect. my. d. d. q. t. es. th. lly. rr. w. t. pha. Fg 3 Th. p. rat. f. g. n. l. h. y. t. ect. my. b. gn. g. f. si. If. th. t. ru. ry. l. ang. th. Fg Th. t. v. ci. f. Sh. h. dt. ry. h. ld. t. d. w. ul. t. lly.

able. Fortunately the patient is less affected than the ugeon and in no case has it been necessary to open the abdomen. With care adhesions to testine or ome tum may be brought down divided and ligated under guidance of the eye. The operation should not be a blind one. Every step should be visible but the operator must accustom himself to the small window and be satisfied with seeing only the small area where he is working.

One patient had adhesions between the fibroid and the navel one had adhesions from a previous ventral suspension. Intergumentous fibroids are very accessible by the vagina and the stiffness of cystic fibroids does not prevent the removal and extraction contrary to the statements of earlier writers. One patient had gone about bleeding daily for over 2 years finally with the haemoglobin 2 and with the red cells numbering 1,700,000. A fair sized fibroid hung from the vagina attached to a completely inverted uterus.

Forty-three hysterectomies were done for hyperplastic endometrium without tumor has been the most common symptom excised. If we can practically eliminate the mortality from ag-

inal hysterectomy then it may properly compete against the use of diagnostic curettage and adjuvant on the basis that it more surely eliminates the possibility of lingering or of later malignancy and that it is not followed by relapse or radium neuritis.

In over 13 cases the hysterectomy was complicated by ovarian tumors which were removed through the vagina. Of these there were 9 ovarian cystomata 2 ovarian dermoids 1 ovarian fibroma and 1 suppurated ovarian carcinoma. Carcinoma was present in the vagina in the corpus uteri in 2 in the cervix in 8 cases.

In one carcinoma of the cervix the left ureter required dissection. Vaginal hysterectomy however is not advocated for well developed carcinoma of the cervix. In certain selected cases of adenocarcinoma of the fundus by first carefully cutting the uterus and packing the cavity with gauze thoroughly wrung out of zinc chloride solution to prevent dissemination of malignant cells the vaginal approach may be attempted provided the uterus can be removed without morcellement. With the aid of the opening of the cancerous uterus during its delivery. For example in the case of a very anæmic and obese virgin 61 years

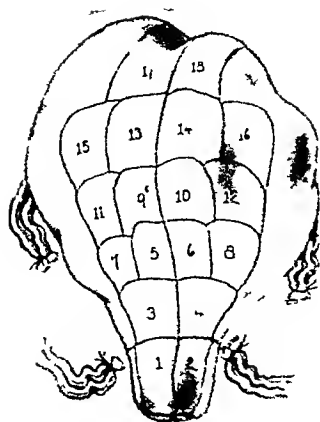


Fig 10

Fig 10 If the uterus is too large or too fixed for delivery, after ligation and division of the lower lateral blood vessels, it is removed by bisection or morcellation in the conventional way

Fig 11 After inspection of the pelvis, the peritoneal and vaginal margins are united over the vascular pedicle by a continuous suture of fine catgut. The peritoneal cavity is

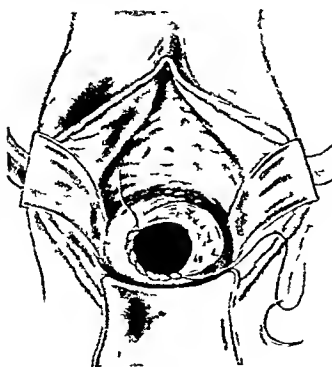


Fig 11

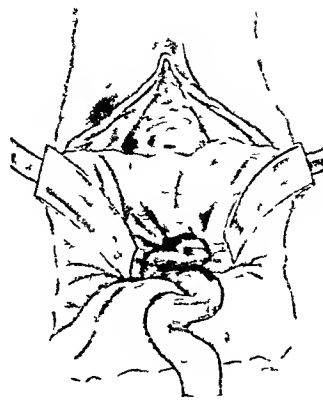


Fig 12

not closed. If there is a tendency to procidentia the broad ligaments are united in the midline.

Fig 12 A Mikulicz drain of iodoform or plain gauze is so introduced into the lower pelvic cavity as to make pressure on the pedicles. Properly introduced, and pushed well up into the vagina, this will not prevent an immediate repair of the perineum.

terior cul-de-sac. While the anterior vaginal margins and overlying bladder are well retracted, the uterus is pulled down and back toward the coccyx, the anterior wall of the cervix and lower part of the uterus is split in the midline, and lateral sections are successively removed. The margins of the resected uterus being repeatedly grasped and everted with traction, new areas are brought into the vaginal field for resection as the morcellation proceeds in the conventional way. To avoid hemorrhage, the lateral margins of the uterus are not invaded. As the fundus is approached, the anterior peritoneal fold appears and is divided without difficulty, and finally the remains of the fundus can be delivered through the vagina and the hysterectomy completed. By keeping close to the uterus, adhesions to the intestines or other parts may be seen and accurately divided, if necessary with the ligation or suture of bleeding points. Fibroid tumors as exposed are grasped, avulsed, rocked, and rotated from their capsules, or are split and delivered in sections. It may be necessary to morcellate large pedunculated fibroid tumors in order to deliver them. Ovarian tumors, especially dermoids, may be removed with greater facility after the uterus is out of the way.

Finally with a patient in a high Trendelenburg position, clots and liquid blood are sponged from the pelvic cavity, which is carefully inspected for bleeding or residual disease. If the patient is well relaxed, as is usual under spinal anesthesia, the

intestines gravitate from the pelvis, which can then be thoroughly examined. Not infrequently the appendix is seen and may be drawn by sponge forceps down to the vaginal opening, examined, and, if necessary, removed. For a vaginal appendectomy, the meso-appendix is clamped and divided, the base of the appendix is doubly ligated, divided below the ligatures by a small cautery, and the cords of one of the ligatures used to tie the meso-appendix over the stump. A small electric light on the side of a narrow, long bladed trowel and the use of a special long posterior vaginal retractor are of great aid. In no case of attempted vaginal hysterectomy have we encountered difficulties too great to be overcome from below although in a number the tumors have extended somewhat above the level of the umbilicus.

The operation is completed by uniting the peritoneal and vaginal margins around the entire circular incision by a continuous suture of fine catgut. This suture catches the ligated pedicles, which are carefully pulled down to the lateral vaginal margins and largely covered by peritoneum as an important protection against secondary hemorrhage, or an infection from an infected pedicle slipping back into the pelvis. If there is prolapsus, support for the vaginal walls is obtained by uniting and perhaps overlapping the round, broad and uterosacral ligaments, a perineorrhaphy and, occasionally, an anterior col-



Fig 7

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F g 9

the left and right uterosacral ligaments are demonstrated ligated and divided. Under the firm traction there usually follows a decided descent of the uterus into the vagina. With division of the ligaments the peritoneum is also opened. A narrow trowel is carried through the peritoneal opening the uterus is lifted forward and a narrow pad with attached tape is carried high into the pelvis to wall off the intestines and to absorb wound secretions. If there is free bleeding which is unusual the vaginal and peritoneal margins are united by sutures.

The partially mobilized uterus is again pulled strongly down and to the right and the bladder and upper vaginal margin is pushed upward and to the left by the trowel. Then with a slight further separation of the parametrium the clotted vessel near the point of junction of the uterine and ovarian arteries is seen hugging the anterolateral side of the uterus. By catgut like wise carried by a curved needle these vessels are tied at one or more points and are divided. The ligatures close to the uterus upon each side. As these vessels are divided the anterior peritoneal fold may be penetrated thus opening the anterior cul-de-sac. If at the ligation and separation of the parametrial tissues continue at each side of the uterus until the anterior cul-de-sac is entered. Unless the body of the uterus is fixed in the pelvis by its large size or by very dense adhesions it may largely be withdrawn through the vagina with the trowel holding up the anterior vaginal margin the fold of peritoneum anterior to the uterus is divided from side

to side. By hugging the uterine body and by pressure acting with the trowel the bladder and ureters are not exposed or injured. The trowel is now introduced into the pelvis anterior to the uterus the bladder is elevated and the uterine fundus is grasped with volsellum forceps brought through the anterior peritoneal opening while the cervix is being released and pushed back into the hollow of the sacrum. Each tube and ovary is now brought into view for final inspection and dissection and the removal of the uterus is completed. The appropriate ligations and division of the round and infundibulopelvic ligaments. Or if the uterus is large and the exposure of the appendages difficult hemostatic forceps are successively applied near the cornua as the round ligaments tubes and ovarian ligaments are divided and the uterus is cut free first upon one side and then upon the other. With the uterus out of the way the tubes and ovaries are inspected and are dealt with either conservatively or radically as may be indicated. Ligatures of catgut may be used. It simplifies the operation if both tubes and ovaries are not removed. Usually we remove the tubes but conserve either both ovaries or at least a part of one ovary. If the patient has passed the menopause of course this is unnecessary to save ovarian tissue. For large uterine tumors myomectomy is often necessary. If myomectomy is required the vaginal section at the fundus is made and division of vessels lateral to the uterus as high as possible are first completed. The posterior cul-de-sac is opened but no special attempt is made to open the an

middle aged women, it gives a mortality about as low as that of radium, without the sequelæ and relapses of the latter and with greater assurance of disclosing and eliminating a possible malignant condition

A fibroid tumor at least up to the size of a 7 months gestation may be removed through the vagina. The approach avoids the secondary complications, such as hernia and parietal adhesions peculiar to abdominal incisions

8 Associated with the hysterectomy, it is possible to do a radical or conservative operation on the appendages and occasionally to remove a diseased appendix through the vagina, as well as to do an associated vaginoplastic operation

9 Vaginal hysterectomy is the operation of choice, if hysterectomy is required in the presence of hæmorrhage or infection. Hæmorrhage during operation is better borne by the patient subjected to vaginal than to abdominal hysterectomy

10 Symptoms from postoperative adhesions may rarely occur after vaginal hysterectomy, but probably less frequently than after abdominal hysterectomy

11 Although easily borne by the patient, vaginal hysterectomy may be much more trying to the surgeon than an abdominal hysterectomy for the same condition. Who however, would weigh the comfort of the operator against the safety of the patient?

perthaphy being done Drainage of the pelvic cavity is used in all cases The center of a 30-centimeter square of iodoform gauze is carried through the vaginal opening into the pelvis on a narrow trowel and with the aid of two right angled narrow retractors or trowel a snug packing with one loop or a number of short strips of gauze is laid against the pedicles This packing should be inserted and pushed well up into the vagina before a perineorrhaphy is attempted A mushroom catheter is finally introduced into the bladder to remain for 2 days the dressings are dusted with sterile boric acid powder and a pad held by a T bandage applied

POSTOPERATIVE TREATMENT

The bladder is irrigated with boric acid solution at the end of 48 hours 8 cubic centimeters of a 20 per cent mild silver protein are instilled and the catheter is withdrawn The central strip of packing is withdrawn on the fifth day and the external bag of the iodoform packing on the sixth day provided it is not unduly adherent No packing is reinserted Rarely is it necessary later to push the finger through the vaginal vault to relieve a secondary purulent accumulation as often collects when the vaginal vault is closed by suture If there has been no perineal repair the patient is permitted to be out of bed on the eighth day and to go home on the tenth day A week or two later the vault is inspected and if excessive granulations are found which is more likely if the tubes have not been removed these are destroyed in the office by a fine pointed electric cautery These granulations usually cause a postoperative leucorrhoea

ADVANTAGES

The operation has the following advantages
1 Clamps are not used The sloughing the odorous discharge the tendency to hemorrhage which follow the use of clamps are largely obviated We have had no postoperative hemorrhage from this operation Clamp takes no room and if the uterus is large and vascular requiring morcellation they may be difficult to apply until there has been an excessive loss of blood Unless carefully applied and isolated by gauze clamps may cause serious pressure lesions of the vaginal wall ureters bladder or intestines By tying the uterine artery and the large descending branch of the ovarian artery before incising uterine tissue it is usually possible to do a necrotic morcellation of a large and vascular uterus without dangerous loss of blood

2 Individual ligations applied under direct vision are used The mass ligation of the broad

ligaments unless very carefully made is dangerous from the tendency of the arteries to retract from within the pedicle and to bleed

3 The lateral uterine attachments are separated at the first part of the operation thus giving an early mobilization of the organ Thus we have found it possible to remove soft fibroid cystic and muscular uteri which have been classed as contraindicating vaginal removal

4 No special attempt is made as is customary to separate the bladder or to locate the peritoneum in the anterior or posterior cul de sac As the uterus is progressively liberated from its lateral supports it descends and the peritoneal folds readily come into view without being sought The anterior cul de sac is entered rather late in the operation Thus there is little danger of injuring the bladder or ureters Only in a case in which the cervix had previously been amputated and a recurrent carcinoma was present have I opened the bladder while attempting to follow this technique I have seen no case of ureteral injury and indeed this seems an unlikely accident if the retracting trowel is carefully used and the ligations made close to the side of the uterus as directed The trowel lifts the ureter from the side of the uterus

5 The removal of a large fibroid uterus through a small vagina is often a tedious operation with much morcellation yet usually it is very well borne by the patient An important underlying principle is not to attempt to expose at one time a larger field than is required for the particular step of the operation It may be that the area in view at one time is no larger than a half dollar yet this is sufficient accurately to separate tissues to introduce a ligature Vaginal hysterectomy need not be a blind operation Every step should be under control of the eye but the surgeon must be content often to see but little at one time

6 With a vaginal nulliparus or atrophic vagina a division of the vaginal wall is at times necessary A shallow median posterior incision of the episiotomy type to divide the lower half of the vagina and to extend occasionally a short distance into the perineum usually suffices We have found no necessity for using the extensive lateral incision of Schuchardt which is carried to one side of the anus back to the coccyx except in malignant disease

7 Owing to the slight tendency to peritoneal infection on the whole a vaginal hysterectomy has a lower mortality than a supravaginal hysterectomy and a distinctly lower mortality than a complete abdominal hysterectomy In the treatment of hemorrhagic conditions of the uterus in



Fig 2

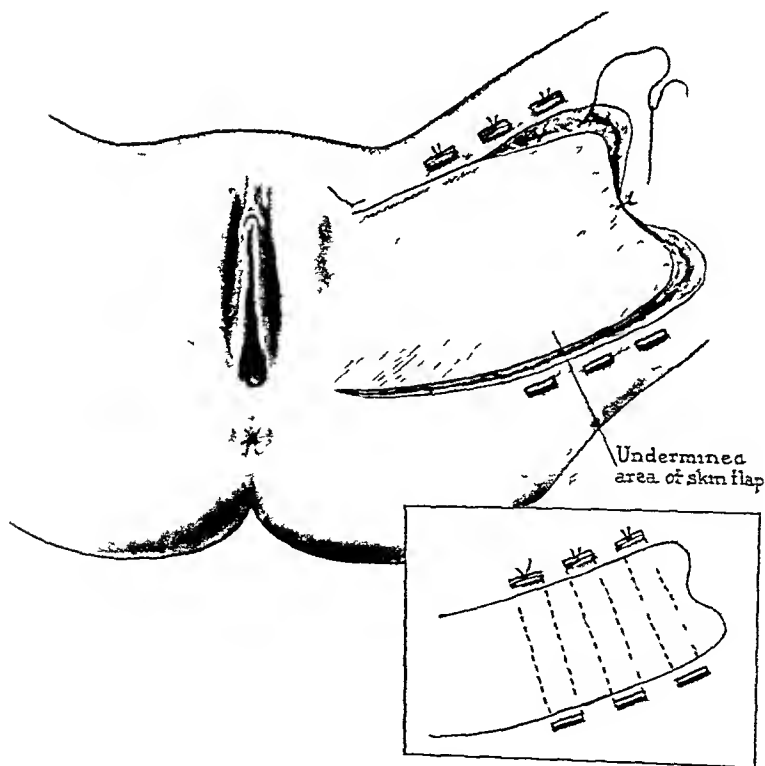


Fig 3

FROM THE CLINIC OF THE WOMAN'S HOSPITAL NEW YORK

THE TECHNIQUE OF FORMATION OF AN ARTIFICIAL VAGINA

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FOR the past decade cases of congenital absence of the vagina have received a good deal of attention from gynecologists. Various surgical methods have been proposed for the relief of this condition by the formation of an artificial vagina. These surgical methods can be classified into three different groups.

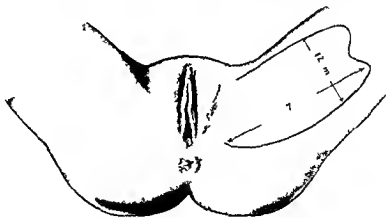
In the first group are the method of Kustner, Mackenrodt and Graves in which the operation is designed to create a space between the rectum and the bladder the walls of the cavity being lined with tissues obtained from the vulva and labia. The function of such a cavity would be that of a receptive organ—a vagina. This skin grafts have also been tried but none of these methods has met with great success. Neither did the Fraenkel method of immediate flap transplant give better results because in this as in the other methods surgical provision was not made to create a tube which could serve as a receptive organ and no surgical procedure to form an artificial vagina can succeed unless a definite receptive organ is created. In the methods in the first group the space obtained by cleavage of the bladder and rectum becomes obliterated in spite of the fact that the denuded wall of the cavity has been lined with tissue from the vulva and labia.

In the second group is the method of Ball. He uses a loop of small intestine which he places between the bladder and the rectum to form the vaginal canal. This operation necessitates a laparotomy and resection of the intestine and it is a question whether this is entirely justifiable. The operation has been successful in some cases but it carries a 50 per cent mortality. Furthermore in many instances patients who have been successfully operated upon by the Ball's technique complain of a disagreeable mucous discharge.

In the third group is the operation proposed and practiced by Frank and Gest. In this operation a definite vaginal canal is created from the skin of the inner aspect of the thigh of the patient. It is a modification of this operation that I wish to discuss.

The object of my technique is to obtain a skin flap from the patient's thigh from which to create a vaginal canal. A skin flap from this area will be easily pliable, easily handled and not subject to contraction. With the technique to be described this skin flap undergoes a certain degree of physiologic contraction and it will have good circulation so that it will not be in danger of sloughing.

The operation has to be done in several stages. The first step consists in preparing a skin flap.



Fig

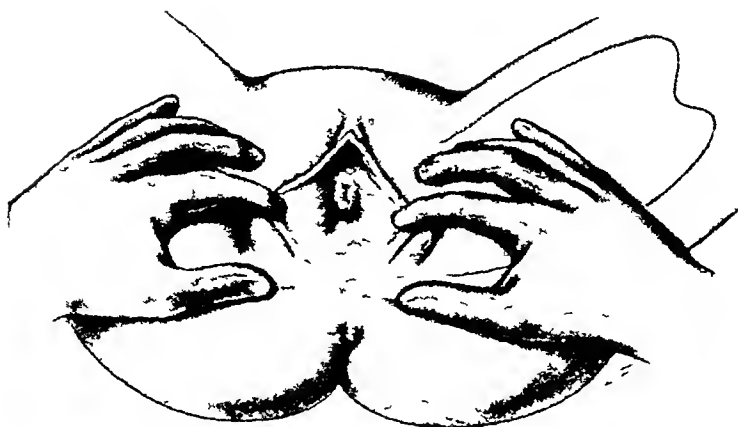


Fig 2

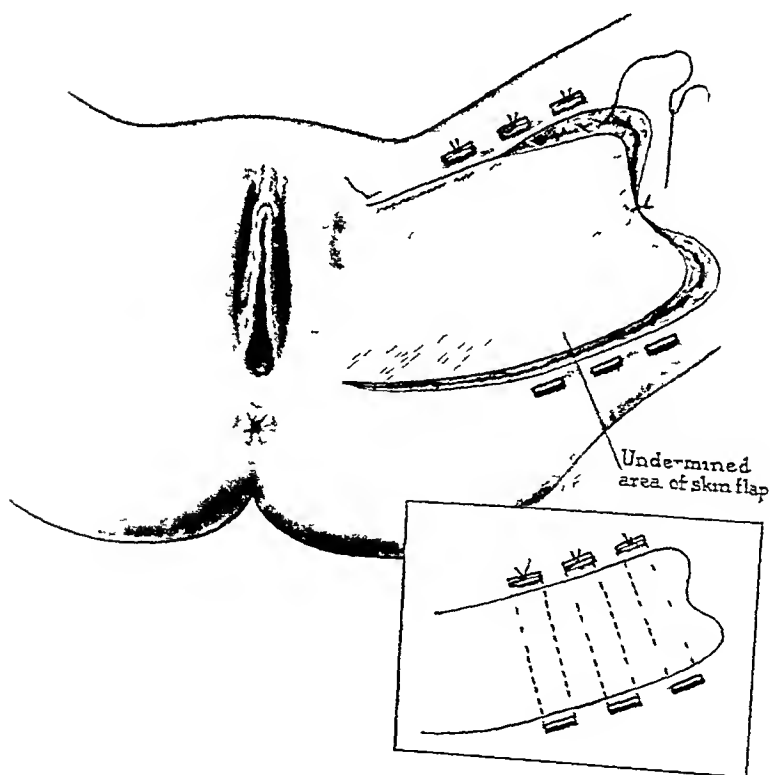


Fig 3

FROM THE CLINIC OF THE WOMAN'S HOSPITAL NEW YORK

THE TECHNIQUE OF FORMATION OF AN ARTIFICIAL VAGINA

HERMAN GRAD M.D. F.A.C.S. NEW YORK

ASSISTANT SURGEON

FOR the past decade cases of congenital absence of the vagina have received a good deal of attention from gynecologists. Various surgical methods have been proposed for the relief of this condition by the formation of an artificial vagina. These surgical methods can be classified into three different groups.

In the first group are the methods of Kustner, Mackenrodt and Graves in which the operation is designed to create a space between the rectum and the bladder the walls of the cavity being lined with tissues obtained from the vulva and labia. The function of such a cavity would be that of a receptive organ—a vagina. Thiersch skin grafts have also been tried but none of these methods has met with great success. Neither did the Fraenkel method of immediate flap transplant give better results because in this as in the other methods surgical provision was not made to create a tube which would serve as a receptive organ and no surgical procedure to form an artificial vagina can succeed unless a definite receptive organ is created. In the methods in the first group the space obtained by cleavage of the bladder and rectum becomes bliterated in spite of the fact that the denuded wall of the cavity has been lined with tissue from the vulva and labia.

In the second group is the method of Ball. He uses a loop of small intestine which he places between the bladder and the rectum to form the vaginal canal. This operation necessitates a laparotomy and resection of the intestine and it is a question whether this is ever justifiable. The operation has been successful in some cases but it carries a 20 per cent mortality. Furthermore in many instances patients who have been successfully operated upon by the Ball method technique complain of a disagreeable mucous discharge.

In the third group is the operation proposed and practiced by Frank and Geist. In this operation a definite vaginal canal is created from the skin of the inner aspect of the thigh of the patient. It is a modification of this operation that I wish to discuss.

The object of my technique is to obtain a skin flap from the patient's thigh from which to create a vaginal canal. A skin flap from this area will be very pliable, easily handled and not subject to contracture. With the technique to be described the skin flap undergoes considerable degree of physiologic contraction and it will have good circulation so that it will not be in danger of sloughing.

The operation has to be done in several stages. The first step consists in preparing a skin flap.

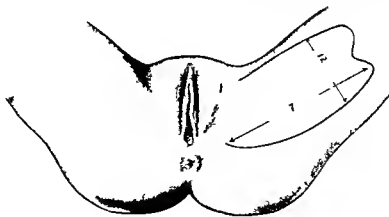


Fig.

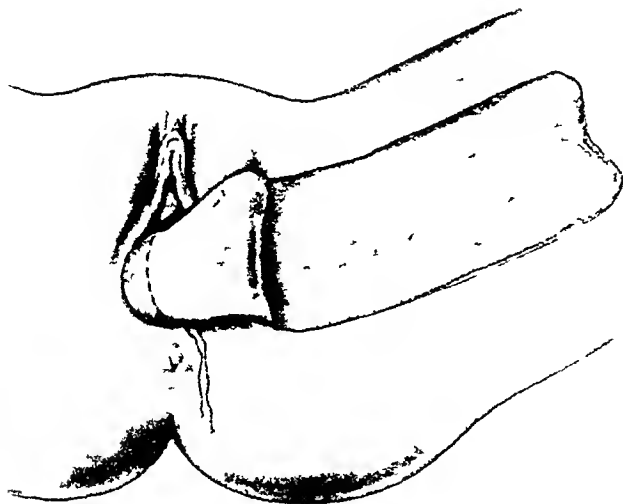


Fig 6

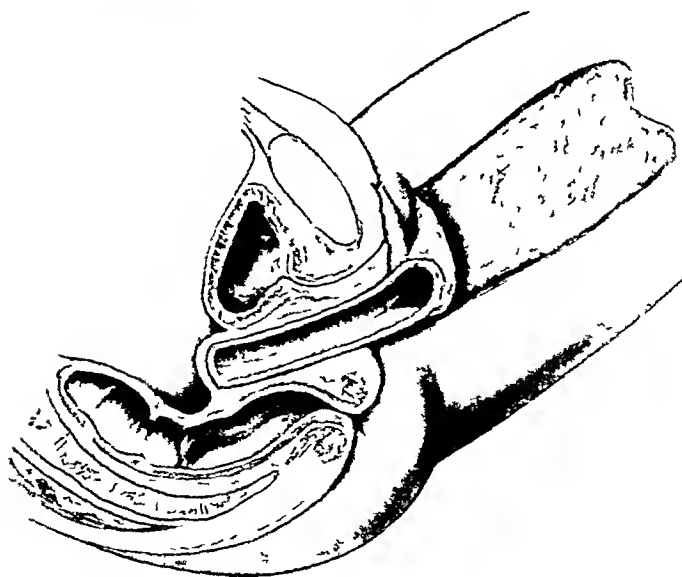
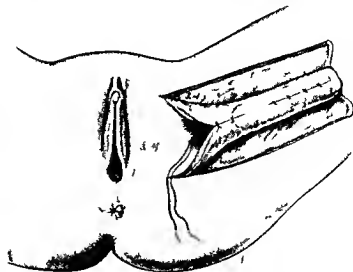


Fig 7

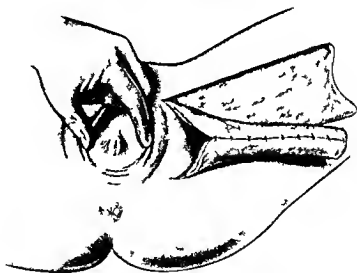
has disappeared from the line of incision in the skin, the flap is ready for the second step of the operation

In the second step in the preparation of the skin flap, the previous incision in the skin is reopened and the skin flap is undermined throughout its full length and breadth, except at its base near the

vulva. The object of the undermining is to sever all the blood supply from the flap except at the base and thus to compel the skin flap to obtain its nutrition entirely from this point. After the skin flap is loosened and all bleeding points are tied, the flap is sutured back to its original position with a subcuticular stitch. A few tension stitches



F 4



F 5

outline of the flap is made on the inner aspect of the thigh below the pubic hair line. The skin flap should be 17 centimeters long and 12 centimeters across and should be curved at the end as shown in Figure 2. The incision is carried to the full depth of the skin so as to sever the blood supply

The skin flap is then undermined to the extent of about one-half inch past the arterial circulation in that part of the flap as shown in Figure 3. After it is undermined the skin is sutured back to its original position by means of a subcuticular stitch of silk thread in gut. When all soreness

Having prepared the vaginal tube, an incision is made in the vulva, as shown in Figure 5. The bladder and rectum are separated from each other. The separation of the bladder and rectum must be so complete as to create a large space and it should be possible to palpate the sacral bone. Into this space in the pelvis, the free end of the vaginal tube, with a rubber tampon inside, is tucked, so that it rests between the bladder and rectum. The newly incised wound in the vulva is sutured around the vaginal tube as shown in Figure 6. A self-retaining catheter is placed in the bladder and a dressing is applied on the vulva and labia.

Five or six days later a series of incisions are made in the base of the skin flap so as to sever the vaginal tube from it. These incisions are made at intervals, 3 days apart, until the vaginal tube is completely severed from its base. It will take about 6 weeks to accomplish this. In the meantime, the catheter in the bladder remains in position, with daily cleansing. When the base of the flap has been severed from the vaginal tube, it is placed in its original position on the thigh, as shown in Figure 7. The rest of the granulating surface on the thigh is covered with Thiersch grafts, as shown in Figure 8. The grafts take readily and within another week the patient will be able to leave her bed. It will be noticed at this step that there is a tendency on the part of the vaginal tube to contract at its outlet. All efforts are now directed to keep the rim of the tissue at the orifice of the vagina from contracting by continued and repeated dilatations. This is accomplished by keeping in position a vaginal plug of large size. The patient is instructed to wear this vaginal plug at night and as much of the day time as she can afford to give up for this purpose. Effort to dilate the orifice of the vagina must be persisted in for several months, but after the parts are fully healed no further contraction will take place, and a permanent vaginal canal will have been established.

REPORT OF CASE

Mrs. K. G., aged 22 years, was admitted to the Woman's Hospital February 5, 1929. She was a native born American and had been married 5 months. Her chief complaint was absence of menstruation and dyspareunia. She had been living with her husband for 5 months and had never been able to have intercourse. She weighed 110 pounds and was 5 feet 3 inches tall. She had a systolic pressure of 135 and a diastolic of 85. Examination of her heart and lungs was negative. The abdomen showed no abnormality. Examination of vulva and external genitalia showed normal labia majora and minora. Her clitoris was normal. The introitus was closed and the urethra was dilated. The perineum looked normal. A rectal examination showed the absence

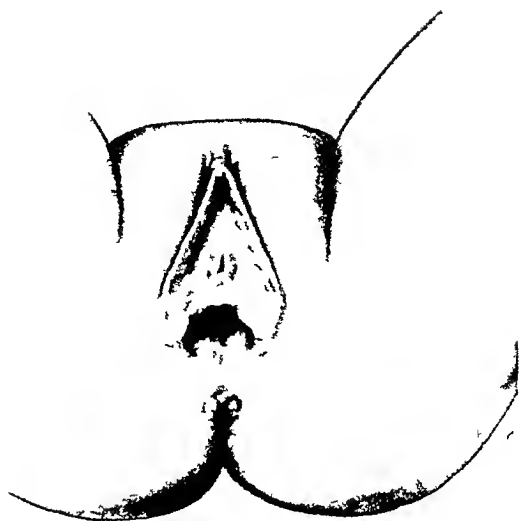


Fig. 10

of uterus tubes, and ovaries. Diagnosis of congenital absence of vagina was made. Examination of the urine showed it to be normal. Blood examination showed 3,800,000 red cells, 86 per cent hemoglobin and white cells 7,200 polymorphonuclears 74 per cent, Wassermann negative. A bladder sound through the urethra and with the finger in the rectum showed very little tissue between the sound and the finger. Rectal examination with two fingers in the rectum failed to show the presence of the uterus or adnexa. On February 14, 40 cubic centimeters of blood were drawn for sex hormone test. The result was mild positive reaction, showing presence of sex hormone, ovarian tissue probably present.

An operation for the creation of an artificial vagina (first stage) was done February 19, 1929. A pattern of rubber tissue was laid on the thigh to outline the skin incision, the skin was incised, the bleeding points were picked up and tied, the flap was undermined, and the skin was sutured back to its original position with a subcuticular stitch. A dressing was applied.

Three weeks later the line of incision was reopened, the flap was undermined for about one half of its length and was sutured back to its original position.

Six weeks later the flap was freed entirely from the underlying tissue except at its base so that it must necessarily receive its nutrition only from its base. The flap was very pliable and was once more sutured back to its original position.

One month later the skin flap was again freed from its attachments, and with good circulation in the flap, its edges were sutured together with continuous chromic catgut sutures to form a tube about 4 inches in length and 2 inches in diameter. The tube thus formed was to be placed in the space between the rectum and the bladder. An incision was made in the vulva and by blunt dissection the rectum and the bladder were freed from each other and a space was formed about 4 inches in length and 3 inches in diameter. The walls of the rectum and the bladder presented a freely bleeding surface. The vaginal tube formed from the skin flap, distended with a gauze bolster covered with rubber was pushed into the hollow space between the rectum and

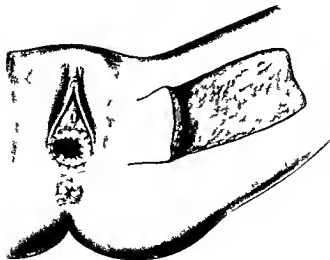


Fig 8

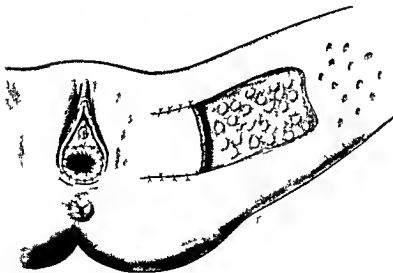


Fig 9

may be taken in the skin as shown in Fig 8 in order to favor the skin flap in contracting on itself as much as possible. A dressing is applied and the skin flap is allowed to heal back to its original position. Nothing further is done with the flap until the soreness from the incision has completely disappeared and the tissues look normal again. The next step of the operation consists in loosening the skin flap already prepared from all

its surrounding tissue except its base whence it receives its nutrition. A gauze is constructed from the skin flap with the keratinized surface inside the tube and the raw area outside as shown in Fig 9. A drape is later tucked between the bladder and the rectum and allowed to remain in this position until it has become firmly adherent to the surrounding parts and is capable of obtaining its nutrition from its new surroundings.

NEW METHOD FOR TREATING FRACTURES, UTILIZING THE WELL LEG FOR COUNTERTRACTION¹

ROGER ANDERSON, M D, F A C S, SEATTLE, WASHINGTON

THIS method to be described was devised to treat injuries of the pelvis, femur, and tibia.

It depends upon skeletal traction of the injured leg and at the same time employs the well leg for countertraction. Even in the face of the modernization of treating fractures resulting from the World War, this new method presents many distinct advantages. It meets the call for economy, not only to patient but to doctor as well. It conserves time through simplification of reduction. The after care is practically negligible because of absence of weight, rope and pulley, so that much worry is eliminated because of the precision of the mechanism. As to the patient, his physical discomforts are greatly minimized, and hospitalization may be shortened—a fact not to be lightly disregarded in the rising costs of injuries. Therefore, in the hope of stimulating better treatment of fractures, we offer this new and original method.

In order to carry out the principle of well-leg countertraction and injured-leg skeletal traction, a new apparatus (Fig 1) was devised. It is simple in construction and use, all necessary traction being furnished by turning the nut with the fingers. By means of this splint we have successfully treated dislocation of the symphysis pubis, injuries and fracture of the pelvis and of the neck of femur, intertrochanteric fractures, and fractures of the shaft of the femur and of the tibia.

Skeletal traction, by means of tongs, wire, nail or pin, has been employed in general practice for years, and the use of the sound leg for immobilization in treating injuries of the lower extremity has been employed for centuries. Ancient history records the army mode of handling broken legs by pulling the injured leg to its normal length and bandaging it to the opposite or well leg in the attempt to keep reduction and immobilization. Modern surgeons have been using the spica cast in treating fractures of the neck of the femur, dislocation of the hip, and pelvic injuries, while such men as Michael Hoke, A Steindler, C K Coonse, and Carl P. Jones have used the sound leg for both immobilization and countertraction.

Although time has not permitted a complete survey of the literature, we have found nothing that contradicts our claim to originality. In addition, all appliances, the use of which has produced results which justify their survival, are listed by contemporary authorities, and again nothing has

been found which would conflict with my method. Therefore, we believe that we are correct in claiming originality for this method of successfully combining skeletal traction of the injured leg with countertraction of the well leg, and for this adjustable splint, by means of which skeletal traction is connected with countertraction.

GENERAL PRINCIPLES OF FRACTURE TREATMENT

Consensus of opinion regarding principles of ideal fracture treatment demands complete reduction as soon as possible following trauma and immobilization so secure that the best function obtains in the shortest time.

Let us evaluate these ideals. Our method provides (1) the immediate reduction of the fracture in the hospital, at home, or in the X-ray room, (2) an easy but accurate reduction without shock-producing manipulation, (3) the maintenance of perfect immobilization, (4) the accessibility of all of the injured area to physiotherapy, (5) the securing of the best of functional results, (6) the consequent better attitude of the patient through this anatomicophysiological fact. That our method fulfills all these ideals will be seen by examination of cases reported here.

Hip fractures. This new method of treatment as applied to hip fractures has been proved sound not only by results but by adherence to the generally accepted principles of treatment, as advocated by Whitman: abduction, hyperextension, and internal rotation. Although the theories agree, our practices are decidedly different, for in our method traction pulls the legs down in a nearly parallel position, while in Whitman's method traction is exerted while the legs are widely separated. It may seem paradoxical to expect abduction with the legs so close together, but radiographic evidence proves that abduction does occur (Fig 2, B). During the movement of reduction, the traction force pulls the acetabulum down on the injured side, while countertraction forces the well acetabulum up, thereby changing the angle of the transpelvic line with the axis of the injured leg, from an acute to an obtuse angle. This in turn forces the angle of the neck with the shaft of the injured femur into the normal position of 135 degrees. (In Figure 2, note transpelvic line *bdc* and long axis of leg, *f*, also angle of neck with shaft of femur before and after reduction.)

¹Presented before the Seattle Surgical Society September 25 1931 and the King County Medical Society Seattle Washington October 22 1931.

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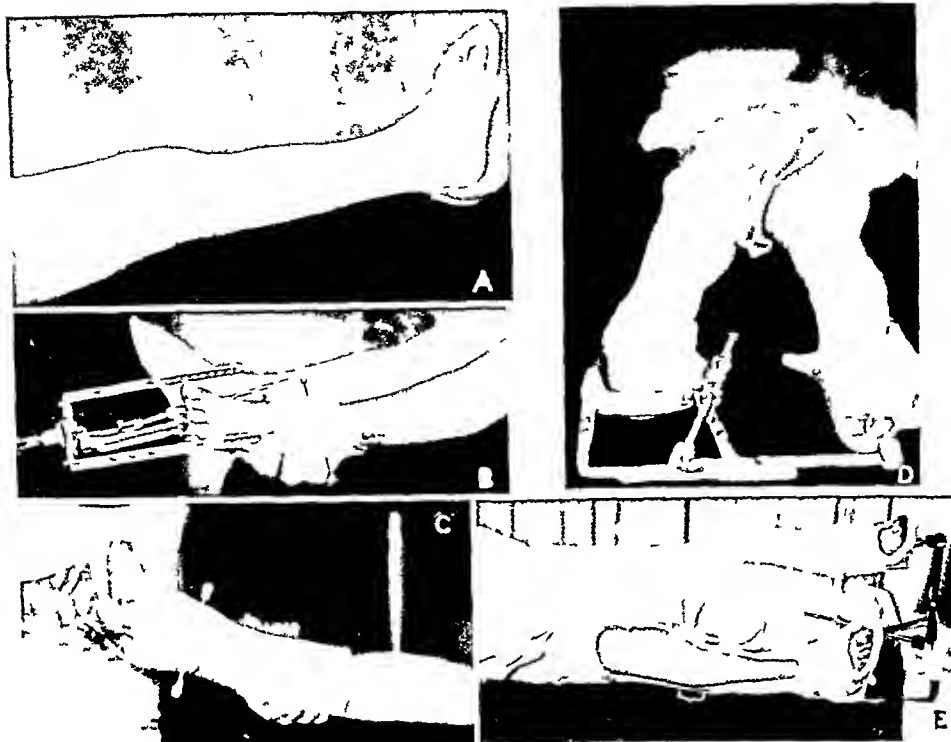


Fig 3 Steps in application of splint and reduction of fracture A Cast applied to well leg B, Pin inserted through distal end of tibia of injured leg C, Pin incorporated in short cast, the ends of the pin having been covered with corks, to be enclosed in cast D, Splint firmly anchored and traction applied E, Part of the anterior portion of cast removed. Lately we have been leaving a transverse band of plaster in the region below the knee, as noted on cut. See case report No. 4

traction stirrup, which is secured by a few turns of plaster bandage. This stirrup is so constructed and should be so applied, that there will be sufficient room between it and the ankle to permit the later exposure of the malleoli.

Next, we prepare the lower end of the tibia above the malleoli for the insertion of the pin, by first cleansing with ether, iodine, and alcohol. Then, this area and that between the fractured ends should be anesthetized with 2 per cent novocain, according to the method popularized by Boehler. As a rule, our patients are previously given a hypodermic of one-fourth grain morphine sulphate.

A solid Steinmann pin is hand-drilled just two fingers' breadth superiorly to the tip of the internal malleolus. A few flat dressings are spiked over the pin ends, then temporarily corked, and one dressing is twisted around each end.

A light cast is now applied over sheet wadding from 1 inch beyond the toe nails to about 4 inches below the knee joint. In a few minutes this plaster

is sufficiently set, so that the stirrup can be brought down and the pin slipped through those perforations which permit the closest approximation of the traction rod to the cast on the sole of this foot. This stirrup and the corks, which are put over the pin ends, are then incorporated in the cast with plaster bandage.

Traction can now be commenced by turning down the nut on the countertraction rod which is so constructed and threaded that over 40 pounds pressure can be obtained by the fingers alone. Therefore care must be exercised not to give too much traction. When the lever arm is about parallel to the distal edge of the frame, the necessary amount of traction will usually have been exerted.

For either external or internal rotation the adjustment device is loosened, when the leg has been rotated to its normal position, it is again secured by screwing down the lock-nut. After apparent length and alignment are reached, a roentgenogram is taken, and adjustments made as indicated.

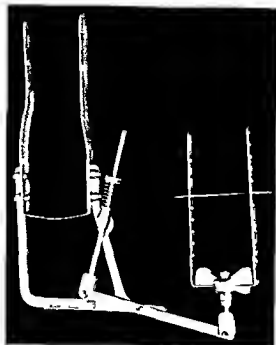


Fig. 9. Original plate method of skeletal traction. The leg is secured to the bar with a strap and a pulley system. A weight is attached to the end of the strap, hanging down. The leg is positioned at an angle, and the apparatus is designed to apply a controlled pull to the hip joint.

Skeletal traction transmits tension to the hip joint capsule, ligaments and adjacent muscle. The body is immobilized and the fragments are held in fixed position between a taut musculo-ligamentous envelope—an internal splint as it were.

As traction displaces the acetabulum down and in the injured side the patient prefers to lie on the bed with the upper part of the body to the right of the injured side, a position he should be encouraged to assume. From a cursory glance the pelvis may appear tilted but close examination clearly shows no abnormal relationship between spine and pelvis and consequently no danger of listhesis because the spine is in its normal position. The angle *bad* (Fig. 3) is obtained in a physiological manner at the hip and not by a pathological callus to the pelvis.

CONSTRUCTION OF APPARATUS

The simple device (Fig. 9) used in our treatment is made chiefly of aluminum castings weighing only 2 pounds. The countertraction port consists of a frame 7 to 8 inches high attached to a flexible countertraction strap. The frame is based on a later molded thigh cast of the iliac leg. A transverse lever, which connects the

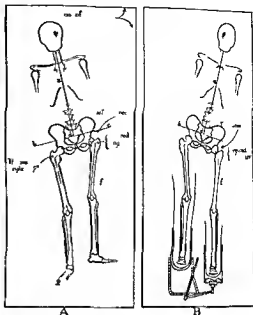


Fig. 3. Diagram A shows a side view of a human skeleton with a traction rod attached to the hip and a weight hanging from it. Diagram B shows a front view of the same skeleton with the traction rod and weight. Various anatomical points are labeled with letters and numbers.

countertraction side to the traction part is pivoted to the frame the axis of which is about 6 inches distal to the level of the well foot. On the added traction rod, which is joined to the end of the lever, is a nut 14 to 16 inches from the frame and a coiled spring 13 to 15 inches from the flexible yet ever constant traction.

The traction portion of the splint is made up of an ether stirrup, 4 to 5 inches perforated sides for the insertion of the pin and is connected to the lever arm by the traction rod through the center of which at its proximal end the traction adjustment with a lock nut is for inter-allo-rotation.

APPLICATION OF THE APPARATUS

The technique of applying the apparatus is simple (Fig. 3). First, a well padded plaster-of-Paris cast is applied to the leg with the hip in a mild adduction. The cast being made to the mid-femur, the heel of the toe is fastened to the mold. In about 5 minutes the cast is sufficiently set to permit the molding of the co-

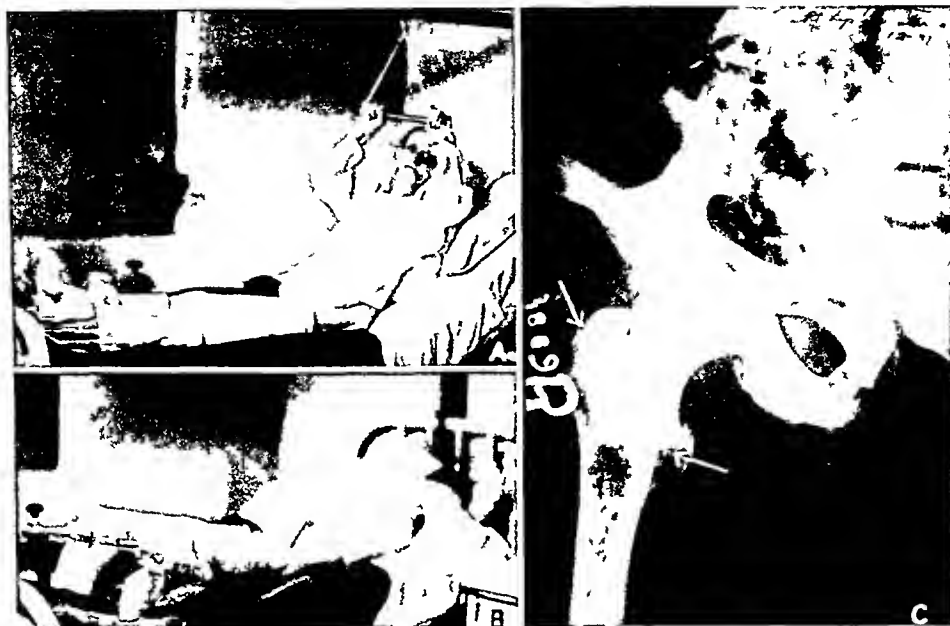


Fig 7 A, Intertrochanteric fracture of right femur. Patient sat up most of the time. B, Patient was incontinent so he was turned over daily. C, Later X rays show perfect reduction in spite of moving. Case 5

ment, the period of immobilization, and the ultimate removal of the cast. Again, let us caution against overtraction, often the cause of non-union in fractures.

Functional prognosis depends upon many factors, even youth and perfect physical condition do not work to the best advantage without benefits of physiotherapy, which can easily and safely

be given by our method, because the injured area is already accessible and all joints can be made accessible by removing anterior portions of the cast.

The period of immobilization is variable. We have found it better to overimmobilize because complications which usually arise from lengthy immobilizing—stiffness of joints and atrophy of muscles—are minimized by our method. For



Fig 8 A, Comminuted intertrochanteric and subtrochanteric fracture of right femur before reduction. B After reduction. Case 6

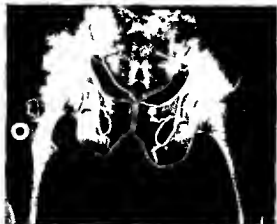


Fig. 4. Fracture of the right humerus immobilized with plaster. See patient's face.

To avoid pressure on the common peroneal nerve the cast is cut out over the posterolateral aspect of the head of the fibula of the well leg. If the patient complains of pain in the heels the cast may be split or cut out in this area. If desired most of the anterior half of the cast of well leg and also that of the injured leg may be removed leaving only a few elastic bands.

The patient need not be removed from the same cart that he entered the hospital on for either roentgenograms or reduction itself. As there is no need for traction table reduction may be carried out in the home or in the hospital bed.



Fig. 5. A. Fracture of the right humerus immobilized with plaster. B. Fracture of the right humerus immobilized with plaster. C. Fracture of the right humerus immobilized with plaster.

but in no case until a preliminary X-ray examination has been made.

Meanwhile the patient's bed has been prepared with a fracture board and a trapeze and if available a Bado frame. The head of the bed is elevated and the back rest may be of immediate use (Fig. 7). Free play of the trapeze enhances his general physical well-being with a resulting increase in circulation, appetite, and mental euphoria. In no way do the benefits—elasticity of bed back rest trapeze—interfere with reduction.

TERM OF IMMOBILIZATION

Progress of the case is checked by frequent roentgenograms which serve as a guide to treat



Fig. 6. A. Fracture of the right humerus immobilized with plaster. B. Fracture of the right humerus immobilized with plaster. C. Fracture of the right humerus immobilized with plaster.



Fig 10 A, Fracture of the shaft of left femur with 2 inch shortening, before reduction B, After reduction, which resulted in overextension, later corrected Note pin through distal end of femur, incorporated in cast Case 7

pin has frequently been inserted through the distal end of the femur above the condyles, occasionally through the crest of the tibia, or through the os calcis or it may be put obliquely through the greater trochanter

The transverse part of the countertraction stirrup can be removed, permitting the application of the splint to the well thigh with the knee straight or flexed, so that countertraction pressure is against the anterior surface of the superior portion of the tibia

Special treatment may be demanded in exceptional cases, as in injury, disease, or deformity of the knee, or in double fracture, that is, fracture of the femur with associated fracture of the tibia of the opposite or well leg, or in badly compounded or soft tissue cases In such instances it may be necessary to apply a pin through the well femur for countertraction, the pin being held by the slots of the countertraction stirrup

It may seem deleterious to the knee joint and its ligaments to reduce the femoral shaft by the application of skeletal traction at the lower end of the tibia, but we have had no sequelæ from its

actual use In order to obtain internal rotation with a pin so placed, it is only necessary to rotate the tibia a little further inward to take care of the slight loss of rotation at the knee Successful usage of the past 5 years warrants these statements

FRACTURES OF THE FEMUR ABOVE THE CONDYLES

Fractures of the femur above the condyles, having long been considered a source of difficulty and worry, can be readily handled with this method The *modus operandi* of treating these fractures is the subject of a paper now in the course of publication (Fig 12)

OPERATIVE CASES

In cases of malunion and non-union of fractures of the leg and in hip and other reconstruction operations, the splint described can be more profitably employed than the fracture table Immobilization without general anæsthetic, is done before the operation—preferably 1 or 2 days before—whereas with the fracture table, it is necessary to apply a spica cast or traction with the patient



Fig 12 A, Lateral view of compound comminuted fracture of right femur before reduction B, Lateral view, after reduction C, Anteroposterior view, after reduction, pin through distal end of femur Case 9

Properties of wide adjustability, without any letting up on traction, not only give greater value for fracture treatment but also for non-union and reconstruction operations

Our method is successfully employed without the application of any plaster to the injured leg

Since all of the injured area and that of the joints on the anterior surface are exposed greater benefits of physiotherapy accrue (Figs 3 E, 7 A and 14)

There is no pressure against the soft part of the injured leg Countertraction is exerted only against the sole of the well foot, physiologically suited for pressure, hence no possibility of pressure sores

This method is more universal in that it treats not only pelvic and hip fractures but also those of the shaft of femur and tibia

This new apparatus is simpler in design and construction, therefore, is less expensive

ADVANTAGES TO PATIENT

To appreciate the advantages accruing to the patient, one must view a case from the time of injury through convalescence Immediate and easy reduction, without general anesthetic, is of

shock-saving importance As this new apparatus is not primarily a hospital appliance, it allows of home treatment or shortened hospitalization, since the transfer home may be accomplished without endangering either immobilization or traction In fact, movement becomes a decided factor in convalescence, the removal of the patient to a solarium or outdoors involving no risk to traction, but a gain in physique (Fig 10, A)

We have long recognized the fact that function depends to a great extent on the correct mental attitude of the patient Keen to the enjoyments of active and passive movements, obtained by massage, trapeze, and back-rest, the patient feels this functional improvement through increased appetite and general well-being (Fig 14) In this way, circulatory and pulmonary complications and stiffness of neighboring joints are avoided, a point to be taken cognizance of especially in the treatment of the aged

ADVANTAGES TO SURGEON

We feel sure that all surgeons have felt the need of a new method, whereby the elaborate equipment of ropes pulleys and weights, which requires constant supervision, or the cumbersome unphysio-

lower tibia, with the application of the usual casts. Patient was very restless the first week and nearly tired herself out by continually sitting up. Because of pain around the malleoli, the casts were cut out. A swelling at first of the well thigh later extended over to the injured leg—it was secondary to a pelvic phlebitis. The cast was removed October 25, 1931. When the pin was removed, only one small drop of blood could be seen and pin had not been dressed for nearly 3 months.

CASE 4 M. J., female, aged 79 years, weight 190 pounds. Diagnosis: intertrochanteric fracture of left femur (Fig. 3). Patient slipped on floor and injured her left hip September 10, 1931. Under local anesthetic a solid pin was put through the lower tibia, with the usual casts. Patient is childish and exhibits other evidences of senility, also has hallucinations and is incontinent. She appears to be in good condition, sits up a great deal, and is turned over on her side daily. She has no complaints. The cast was cut out over the knee and leg.

CASE 5 F. M., male, aged 70 years, weight 98 pounds. Diagnosis: intertrochanteric fracture of right femur (Fig. 7). Patient fell and injured his hip, September 10, 1931. Under local anesthetic, a solid pin was put through the lower tibia, and the usual casts applied. Patient is senile and has arthritis of the hands and feet, with deformities, Dupuytren's contracture of the palms, also opacity of the corneas, with practically a loss of vision. Since patient was involuntary, the nurses had been turning him on his abdomen for some time, before we found this out. Subsequent roentgenograms revealed 100 per cent reduction, so we have continued to have him turned. Patient is still in splint, perfectly content, with no complications.

CASE 6 R. S., female, aged 60 years, weight 140 pounds. Diagnosis: comminuted intertrochanteric fracture of right hip (Fig. 8). Patient fell and broke her hip July 15, 1931. Patient was a mental case, had hallucinations, and was so vicious at times that she would bite and scratch and refuse to be turned. She had involuntary movements and a sore started to form on the buttocks, therefore, the cast was later continued to the ribs on the injured side, when she was easily turned over. Splint, cast, and pin were removed at the end of 2 months, she had good union with about 1/4 inch shortening. Roentgenograms showed a bony union with some slight medial displacement of the upper end of the distal fragment.

CASE 7 J. S., female, aged 11 years, weight 95 pounds. Diagnosis: compound fracture of shaft of left femur (Fig. 10). Patient was seriously injured in an automobile accident July 21, 1931, receiving a compound fracture of the left femur, besides a skull fracture. Internal injuries were suspected, due to vomiting and abdominal pain and distention. Gas anesthetic was given in order that the compound femoral wound could be treated at the same time. Pin was put through the distal end of femur and incorporated in a cast which extended 4 inches above the fracture site. At first too much traction was obtained but this was corrected by loosening the traction nut. The cast on the well leg did not extend above the knee and a pressure sore developed later after she left the hospital, the only incidence of such a result recorded. Patient left the hospital on the fourth day and came under care of others who report that excellent union was obtained, with no shortening.

CASE 8 D. M., male, aged 6 years, weight 58 pounds. Diagnosis: fracture of the center of the shaft of the right femur (Fig. 11). Patient was struck by an automobile October 3, 1931, and came to hospital in a condition of shock. He showed a great deal of abdominal distress, he had superficial excoriations around the thigh also marked deformity and shortening of the right thigh. Ethyl chloride for a few minutes was used while an undivided pin was in-



Fig. 14 Intertrochanteric fracture of right femur. Patient sat up and moved around from the first day, but a firm union was obtained, with perfect end results. Case 11.

serted through the lower tibia. The cast extended to the mid thigh on the well side, to the groin on the injured side. Subsequent roentgenograms revealed good reduction. He was hospitalized only 2 weeks, and is now under the care of his mother.

CASE 9 D. M., male, aged 46 years, weight 178 pounds. Diagnosis: compound fracture of shaft of femur, about 7 inches above right knee joint (Fig. 12). Patient was struck by an automobile, September 12, 1931. Because of the compound fracture, reduction was done under nitrous oxide gas, and a pin was put through the distal end of the femur. To overcome the pull of the gastrocnemius muscle, reduction was obtained by a slight alteration in application of cast on the injured leg. This will be reported in detail in a subsequent paper. The buttocks were so badly bruised and lacerated at the time of the accident that turning on his abdomen, which the nurses had done without orders, caused him pain, and was stopped. Patient is still in the splint, the compound wound has entirely healed under conservative treatment. The last roentgenograms show no shortening.

CASE 10 J. P., male, aged 13 years, weight 105 pounds. Diagnosis: fractured shaft of left femur (Fig. 13). Patient fell off a horse July 14, 1931. The pin was first put through the distal end of this femur which was incorporated in a cast extending to a little above the mid thigh. Later difficulties were encountered, as the pin was defective and broke, so that the cast on the injured leg was removed, another pin inserted through the distal end of the tibia, and a new cast applied up to the groin. The patient was permitted the daily use of a wheel chair and propelled himself around. Excellent end results were obtained, with no shortening. This boy is now attending school, and he directs no more attention to this leg than before the accident.

CASE 11 A. R., female, aged 57 years. Diagnosis: subtrochanteric comminuted fracture of right femur (Fig. 14). The patient, a very large woman, weighing over 200 pounds, fell and broke her right hip, July 22, 1931. She had had infantile paralysis at the age of 2, the right leg remaining short and weak, the foot was in equinus. She had been on crutches until 1922, at which time she was successfully operated on by Dr. E. A. Rich, when the right knee-joint was



Fig 3 A A t pot t w fra t t t t h ft f f m b f ed t
B A t pot n ft dut C L t l w ft ed t C

log cal spica cast could be eliminated. It is be-
cause traction cannot change that ur splint re-
quires such occasional care by the doctor. The
facts that hospitalization is shorted and that
neither anaesthetist nor expensive fracture table
is called for plus the low cost of the apparatus
itself are of economic significance to the doctor as
well as patient. The lay journals are commenting
on the high cost of illness and it would seem that
one way the medical profession could accept this
challenge would be to adopt a method with
simplification of complicated processes which re-
sult in less cost per fracture.

Simplification of technique and after care is the
keynote of this new method. Red t is accom-
plished with ease and the traction table is
not needed for operative or non-operative work
and portable X-rays are not necessary as a pa-
tient may be moved to the X-ray room without
endangering traction or immobilization.

RESUMÉ OF TWELVE CASE HISTORIES

Records of case reports were complete to Octo-
ber 24, 1931, when submitted for publication.

C s E A E mal aged 5 y rs w ght 63
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g f m d both bo es f th right f e arm bo th
w n t U d g n r x t h t sol d p u n was p t h ough th

spreader, also for Buck's extension, and attachments for the Russell and Maxwell-Ruth methods

The original method or its modifications have successfully been used, without application of any cast to the injured leg

The small hospital can now handle these cases as efficiently as the more elaborately equipped hospital, since expensive fracture table, portable X-rays and extensive equipment of ropes, pulleys and weights are nonessential

This new method benefits the patient in shortening hospitalization, minimizing complications and discomforts, and at the same time assures better anatomical and physiological results

Benefits to the doctor are economy of time, in application and especially in after-care, through simplification of the process of reduction and surety of immobilization and traction, plus economy of anxiety through assurance of better anatomical and physiological results

THE SURGERY OF THE UNDESCENDED TESTIS¹

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From the Department of Surgery, University of Minnesota

THE ideal procedure for the correction of undescended testis is placement of the organ into the scrotum before the degenerative changes which occur with puberty have had occasion to obtain. Unfortunately, however, there is no uniform agreement yet as to the disposition which should be made in most instances of undescended testes. The fear of malignancy in the undescended testis has frequently prompted its excision when otherwise an attempt would have been made to place it in the scrotum. The belief that the spermatogenic function of the undescended testis is not improved by bringing it into its normal location has also been a deterrent to the routine performance of orchiopexy.

It was once believed that patients with bilateral failure of testicular descent were like castrates. Sir Astley Cooper when consulted by a medical student presenting this anomaly, informed the unfortunate inquirer to this effect of his predicament, whereupon the young man went out and committed suicide. Cooper then had occasion to examine the testes and found spermatozoa present in both. It is now well known that the interstitial cells in the testis are responsible for the development of the secondary sex characters in the male. They were first described in 1854, but their function was disputed until 1903, when Bown and Ancel finding only the interstitial cells normal and the spermatogenic cells absent in cryptorchid pigs suggested that these cells were responsible for the development of secondary sex characters. The Sertoli cell lying on the basement membrane of the seminiferous tubule has not been as satisfactorily ruled out as playing no part, as has been possible in the case of the germinal cells, but its function is adequately explained as

being that of a nourishing cell. In undescended testes of older patients in whom most of the spermatogenic cells have disappeared, the Sertoli cells are also frequently absent or distinctly atrophic, whereas the interstitial cells remain.

The failure of development of a normal spermatogenesis in the human cryptorchid has always been much of a conundrum and remained a matter of exceedingly interesting speculation until the researches of Carl Moore, of Chicago, demonstrated the scrotum to be a thermo-regulating mechanism. A temperature gradient of several degrees centigrade obtains between the interior of the abdomen and the scrotum. The latter does not exhibit the fat insulating layer possessed by the abdominal wall. External application of heat to the scrotal testis also causes a temporary aspermatic condition to develop. It has also been shown that, when testes of dogs elevated from the scrotum to the peritoneal cavity are returned to their normal position in the scrotum, the testes then become spermatogenic again (Fig. 1).

A comparison of the histological structure of the normal testes of prepuberty age with those that fail to reach the scrotum has failed to demonstrate any difference in most instances. It is also well known that the testis increases very little in size from birth to puberty. The accompanying tables indicate that, after the first year of life until about 13 years, practically no growth occurs in the testes.

Histologically, scrotal and undescended testes before puberty are very similar (Fig. 2). After puberty supervenes, however, the testis that has failed to reach the scrotum makes futile attempts to elaborate a mature germinal epithelium, but adult spermatogenic cells are not continuously



Fig. 5. A. O. m. th. id. m. m. t. d. f. t. f. f. t. b. d. d. b. t. 3. p. d. m. f. l. y. d. f. b. y. 3.
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 n. p. C. A. t. p. o. t. n. w. w. t. h. p. n. p. r. o. p. o. r. a. t. e. d. p. l. a. t.

f. d. Th. p. w. t. d. th. gh. th. t. b. b. th.
 k. W. w. b. l. t. g. t. t. f. t. r. y. t. g. g. m.
 th. th. p. o. t. b. l. p. p. t. t. f. t. h. t. g. m.
 d. p. o. s. t. a. s. d. th. h. u. p. s. d. t. w. e. c. r. y. t.
 m. h. t. th. X. r. a. y. o. o. m. Th. w. c. m. p. h. t.
 d. h. w. r. y. h. p. p. y. p. t. h. t. h. l. f. t. w. d. y. s. b. f.
 th. p. m. d. t. b. e. c. m. l. W. h. th. p. w.
 m. e. d. t. g. m. t. f. d. s. c. h. g. w. p. t. d. t.
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 f. w. d. a. y. f. t. t. m. l. p. t. t. w. r. u. t. h. e. s.
 d. th. l. t. t. g. g. m. l. l. t. d.

C. m. l. g. e. d. 5. y. w. l. t. 300. p. o. d.
 (F. g. 5.) l. t. m. b. l. d. t. A. g. u. t. 3. p. d.
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 t. Th. t. t. m. t. t. f. t. s. o. p. w. p. t.
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SUMMARY

The new method of fracture treatment described depends upon skeletal traction of the injured leg while the patient is in the upright position.

An original splint has been devised on the application of this principle to the connection of the leg skeletal tract with the leg connective tract. While extremely simple it has a wide range of adjustment for abduction or adduction and internal or external rotation may be had at any time without letting up on traction.

This method has been successfully used for the location of the symphysis pubis fractures and factures of the pelvis neck of femur intertrochanteric fracture and fractures of the shaft of the femur and of the tibia.

Fractures of the acetabulum are obtained by displacement of the injured acetabulum down and due to the pull of skeletal tract on while the acetabulum is displaced and due to the pull of the tract on with a tilt to the spine on the pelvis.

This apparatus is a more than suitable substitute for the fracture tract in table operation on nonunion and reconstruction.

The splint is empirically safe. Five years with a single incidence of infection other before or after removal is proof against any adverse criticism.

At the time of the present order the splint is still in the making.

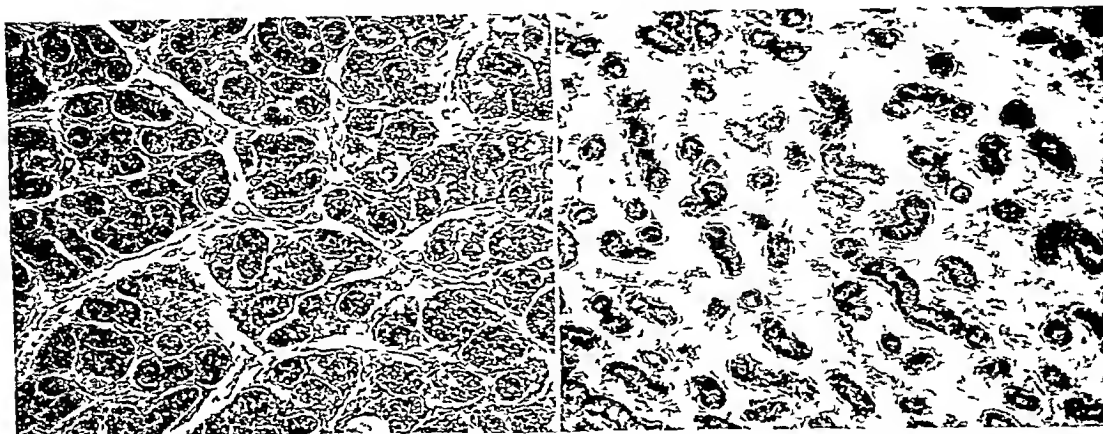


Fig 2 Prepuberty undescended testes. At left, Abdominal testis of a 7 month old premature infant ($\times 85$). At right, Inguinal testis of an 11 year old child. The histological

appearances of these testes are very similar. The mature germinal cells do not appear in the testis before the age of puberty.

DESCENT OF THE TESTIS

Just why the testis fails to reach the scrotum is not easily determined. Eccles classified the conditions which might be causative as follows: (1) conditions associated with the mesorchium, (2) conditions associated with the testis and its component parts, (3) conditions associated with the gubernaculum, (4) conditions associated with the cremaster, and (5) conditions associated with the route along which the testis must pass.

The testis develops in the retroperitoneal space and at birth in normally developed children is present in the scrotum in the majority of instances. The descent of the testis may be divided into three stages: the first two of which are entirely passive as concerns the testis. In the sixth week of fetal life, the genital ridge extends from the sixth to the twelfth dorsal segments, lying on the inner side of the wolffian ridge. During the third month of fetal life, owing to an atrophy of the cranial segments, the testis comes to lie in the iliac fossa, as a consequence of unequal rate of growth of structures below and above the inguinal ligament, the testis later may be found at the future internal abdominal ring. Preceded by the vaginal process of the peritoneum, the testis passes obliquely through the abdominal wall reaching the external abdominal ring during the seventh or eighth month. The scrotum and derivatives of the abdominal wall are preformed to receive the testis. At birth, or shortly after, the upper portion of the vaginal process becomes obliterated but the lower end persists throughout life as the tunica vaginalis propria. Failure of this peritoneal tunic to obliterate constitutes a potential inguinal hernia.

The mechanics of the passage of the testis through the abdominal wall remains unexplained. It has been said that the gubernaculum acting as a tractor drags the testis into the scrotum. Others have insisted that the gubernaculum serves as a rudder steering the testis into its proper location. Instances are reported in which the testis reached the scrotum in the absence of a gubernaculum, and R. H. Hunter¹ has recently stated that in the newborn the testis together with its fascial coverings may be lifted out of the scrotum without tearing anything but a little superficial connective tissue.

John Hunter insisted that the undescended testis was *ab initio* imperfect and believed that this imperfection accounted for the failure to descend. Hunter's opinion has claimed a large number of supporters. Bland-Sutton says, "The testis is retained because it is imperfect. The migratory impulse in the healthy normal testis is irresistible." Many have insisted that it is wrong to speak of atrophy of the undescended testis, believing it to be underdeveloped. Some have insisted that cryptorchidism is essentially a hypoplastic process representing only a portion of a general developmental disturbance. These conditions, however, have been adequately set aside by the labors of experimental workers.

Heredity seems to play a minor rôle in the failure of the testis to reach the scrotum. In the instance of a boy with bilateral retroperitoneal retention of testicles upon whom I operated, there were two other children in the family with undescended testes. In another family it has been my privilege to operate upon two brothers for

¹*Brit J Surg* 19 6 111 1933

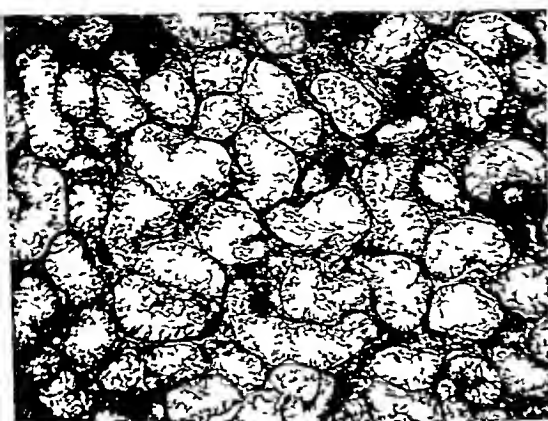


Fig 3 At left, inguinal testis of a boy of 17 ($\times 85$), spermatogonia are present but the more mature germinal cells are absent. At right, inguinal testis of a man of 32, the

interstitial cells are in evidence but only the contours of the seminiferous tubules persist.

belief that the operation is well postponed until the child is 8 or 9 years of age at which time the structures in the spermatic cord have acquired larger proportions, thus facilitating the performance of the operation without injury to the delicate structures. Undoubtedly, however, as Bevan states with practice the operation may be performed on the infant with little hazard. The instances in which descent may occur between birth and puberty are so few that the operation need not be postponed in the hope that the testis may spontaneously descend to its normal location. The undescended testis in the young, however, is immune to the histological changes observed in the post-puberty gland and the operation may well be deferred until 8 or 9 years

of age. As far as I have been able to determine, the prepuberty imperfectly descended testis is usually in every particular much like its fellow in the scrotum. The testes of prepuberty dogs elevated into the peritoneal cavity fail to exhibit the changes observed in the adult dog's testis when transplanted in the same manner.

OPERATIVE PROCEDURE

It is usually the presence of a hernia that brings the patient with an undescended testis to operation. Whereas the visual deformity of cleft lip and palate ordinarily bring the patient to operation early, the little disturbance afforded by an undescended testis is responsible for so many cases seeking operation late in life, when the

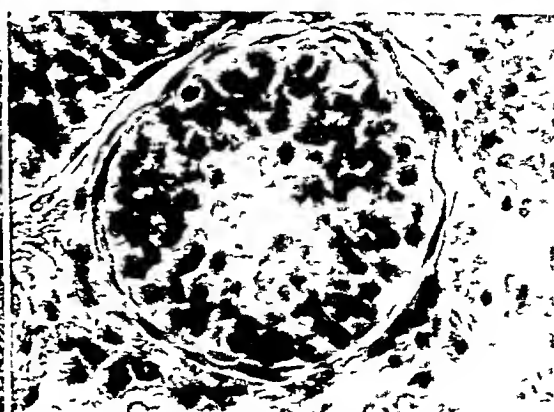
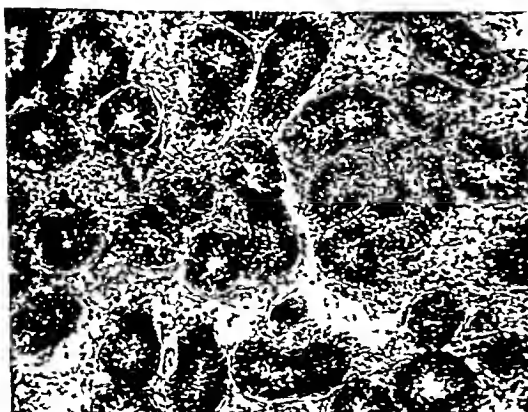


Fig 4 At left, inguinal testis of a boy just over 13 years of age ($\times 85$), spermatogonia and spermatocytes are present in large numbers. At right, the same under higher

magnification ($\times 210$), spermatozoa are not seen. Scrotal replacement should permit such a testis to elaborate a mature germinal epithelium.

TABLE I—AVERAGE WEIGHT OF TESTIS FROM BIRTH TO EIGHTEEN YEARS (MITA)

Ages	Grams
1 yr	6.00
2 yr	
3 yr	
4 yr	
5 yr	
6 yr	
7 yr	
8 yr	
9 yr	
10 yr	
11 yr	
12 yr	
13 yr	
14 yr	
15 yr	
16 yr	
17 yr	
18 yr	

TABLE II—AVERAGE WEIGHT OF TESTIS FROM BIRTH TO FIFTEEN YEARS (WWEDEWSKY)

Age	Weight (gms)		Length (mm)	
	Right	Left	Right	Left
1 yr		6		
2 yr				
3 yr	86			
4 yr	80	3		
5 yr		5		
6 yr		5	5	
7 yr	8	6.5	00	00

undescended testis in one of whom the condition was bilateral. Uffreduzzi particularly has stressed the relation of heredity to the occurrence of undescended testes. Dr W. E. Macklin also a veterinary surgeon informs me that out of 32 male pigs which he castrated for a farmer 12 of the group had undescended testes. Out of the litter from which the sire came 10 brothers had undescended testes.

MacGregor has recently stressed a third inguinal ring as frequently playing an etiological role in cases of failure of descent. It is true that the majority of undescended testis are in the low inguinal region. The migration of the testis from the external inguinal ring into the scrotum seems to be an especially hazardous journey. (It is this area that MacGregor has designated as the dangerous inguinal ring.)

ORCHIOPEXY

There are described in the literature about forty methods of bringing the testis into the scrotum with various modifications. It is difficult by others about 100 names may be named as having contributed something to the elaboration of an adequate method of orchiopexy. Satisfactory operations in a given case rarely limit themselves to one or two procedures.

TABLE III—MEASUREMENTS OF TESTIS FROM BIRTH TO SIXTEEN YEARS IN TWO HUNDRED AND TWENTY ONE BOYS (REICH)

Age	Weight (gms)	Length (mm)		Width (mm)
		Right	Left	
1 yr	6			
2 yr		6	8	6
3 yr		6	8	6
4 yr		6	8	6
5 yr		8		5
6 yr			8	
7 yr		6		8
8 yr		6	8	6
9 yr		6	8	6
10 yr		6	8	6
11 yr		6	8	6
12 yr		6	8	6
13 yr		6	8	6
14 yr		6	8	6
15 yr		6	8	6
16 yr		6	8	6

The very fact that so many methods have been advocated indicate very plainly a general dissatisfaction with the operations of orchiopexy. Study has shown however that if the testis can be gotten into the scrotum before puberty it will probably go on and develop normally. Extensive data fact on the methods of obtaining this end are largely matters of technical concern.

AGE FOR THE PERFORMANCE OF OPERATION

The results of recent clinical and experimental investigation indicate that the undescended testis should be gotten into the scrotum prior to puberty. Bevan has recently urged the early performance of the procedure. It has been m-

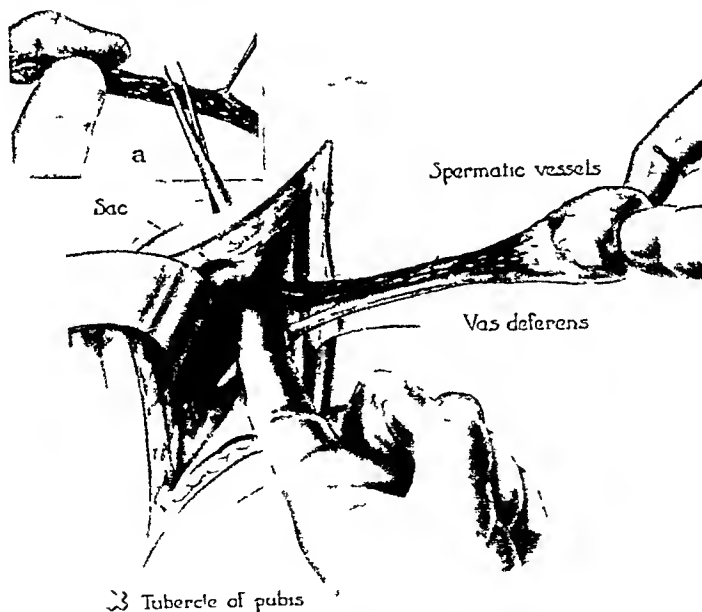
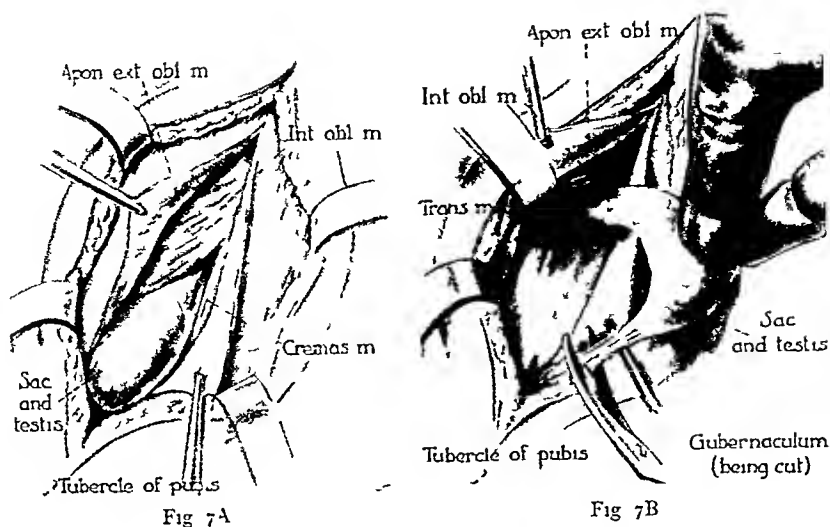


Fig 8

Fig 7 A, Exposure of inguinal canal. The testis is shown at the external ring, the most frequent site of arrest of descent. B, The gubernaculum is cut free from its attachment. Care must be taken not to injure the epididymis which is occasionally found separated from the testis in incomplete descent. The scrotum is dilated manually at this time and a small gauze pack is left in it.

Fig 8 Isolation and separation of the hernial sac is the initial step in the operative procedure of gaining added length in the spermatic cord, occasionally this alone suffices. The next step consists in freeing the vascular bundle of the spermatic cord from its superficial fascial coverings. Employing the index finger as a dissector and with the testis under slight tension, considerable gain in length may be obtained by this maneuver of spermatic



Fig 5A



Fig 5B



Fig 6

Fig 5 A Photograph of the specimen showing the testis and associated structures. Labels include: p, t, l, f, t, d, q, t, l, y, m, b, l, z, g, d, p, l, g, g, u, l, t, t, h, s, c, t, m, B, Th, e, s, t, y, r, s, f, t, p.

Fig 5 B Photograph of the specimen showing the testis and associated structures. Labels include: b, b, t, e, d, t, h, t, a, n, m, b, h, t, r, o, g, t, t, a, t, h, e, d, t, t, a, l, b, u, g, w, p, a, s, s, e, d, t, h, g, t, h, s, c, t, m, d, f, t, e, d, t, h, t, h, h, l, l, w, e, a, f, e, r, y, e, a, d, r, a, b, l, t, h, a, c, u, r, r, e, d, a, s, b, e, c, e, d, t, h, p, h, t, g, r, a, p, h.

Fig 6 A Photograph of the specimen showing the testis and associated structures. Labels include: t, f, t, y, p, t, p, r, a, t, l, t, h, d.

occurrence of hernia brings them to the surgeon. In patients past 30 years of age, when the undescended testis is often completely atrophic, the same indication does not exist for anchoring the testis in the scrotum as obtains in younger individuals. It has been demonstrated for the rabbit and guinea pig at any rate that one sixteenth of a normal testis suffices to permit the development of the secondary sex characters.

The size of the testis is a fair criterion of how it will react to being placed in its natural habitat. A small atrophic organ from which the germinal cells have disappeared will probably exhibit no growth whereas in a testis of fair size in a patient past puberty it may be assumed that the young germinal epithelium capable of elaborating the mature germinal cells still survive. In the prepuberty testis it must be recalled that the normally descended testis is also atrophic to palpation.

The development of the operation of orchiopexy is indelibly linked with the name of Bean. The modern operation as it known today is largely the result of his efforts. He has stressed particularly the fact that the separation of the vaginal process from the other elements of the spermatic cord combined with the removal of the coverings of the cord will stimulate the testis that in most cases it may still be placed into the scrotum. A particular of paramount concern however is that such a testis stripped of the cremaster muscle and all the fascial coverings frequently retracts. Vessels are elastic and are no longer than they have to be and undoubtedly play a significant rôle in the subsequent development

of the testis. At the time of operation the testis stripped of its fascial coverings may frequently be placed with comparative ease on the thigh below the bottom of the scrotum. On the completion of the operative procedure the testis lies free at the bottom of the scrotal sac but a few days later when the wound is inspected retraction of the testis out of the scrotum may frequently be observed. The scrotum also may play a part in this subsequent elevation. It has been operated upon several cases by Bean's technique placing the testis in the bottom of the scrotum freed from all fascial connections the testis remaining suspended by itself and was deferred alone. Much to my chagrin and disappointment the testis has later become elevated to a position high in the scrotum. Figure 5 illustrates a case which occurred. Later I was prompted to fix the testis to the bottom of the scrotum and passed a long strip of linen placed in the tunica albuginea through the bottom of the scrotum anchoring this traction suture to the mid thigh by adhesive tape to hold the testis on the stretch. The thigh was kept extended for 2 weeks after which time the traction suture was cut and the patient was allowed up. The immediate result was better than the hole than when no traction was used at all. An examination of these cases after an elapse of time recalled the fact that the majority of them had retracted into the upper or mid scrotum (Fig 6) and compared with the other testis indicated that it led to the same result which occurred in the normal testis.

In recent years I have practiced an operation of my own design which might be described as a

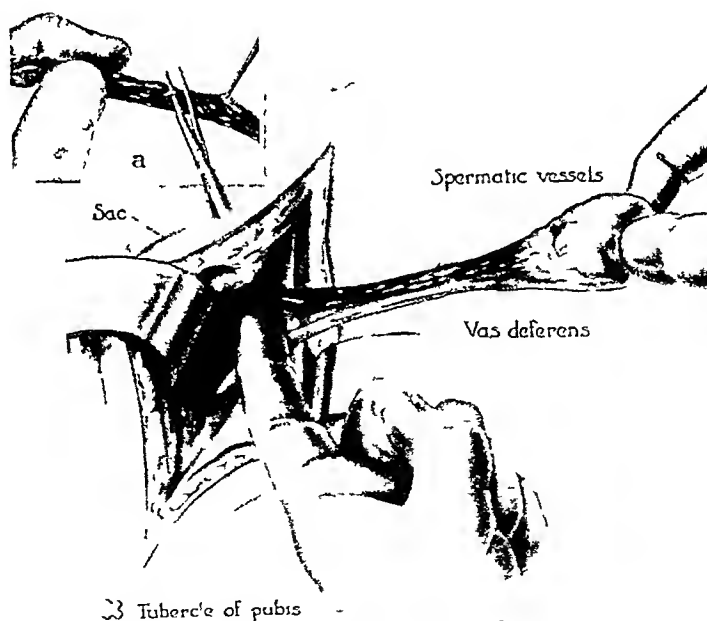
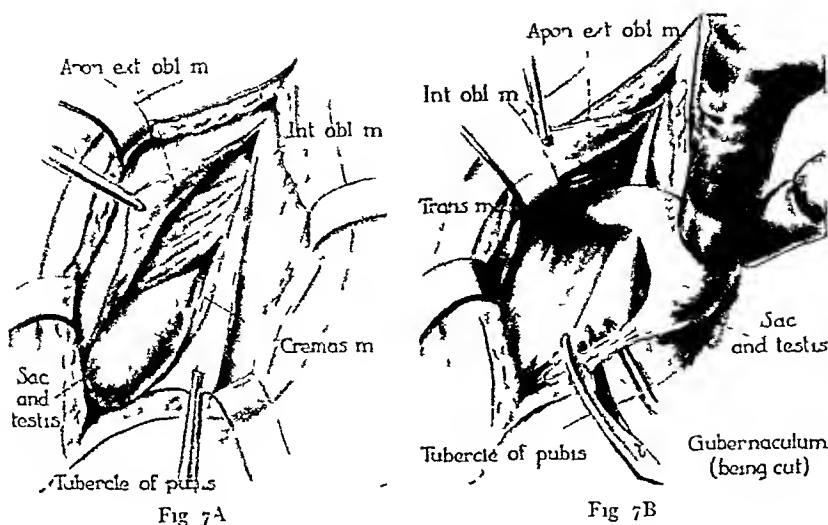


Fig 8

Fig 7 A, Exposure of inguinal canal. The testis is shown at the external ring, the most frequent site of arrest of descent. B, The gubernaculum is cut free from its attachment. Care must be taken not to injure the epididymis which is occasionally found separated from the testis in incomplete descent. The scrotum is dilated manually at this time and a small gauze pack is left in it.

Fig 8 Isolation and separation of the hernial sac is the initial step in the operative procedure of gaining added length in the spermatic cord occasionally this alone suffices. The next step consists in freeing the vascular bundle of the spermatic cord from its superficial fascial coverings. Employing the index finger as a dissector and with the testis under slight tension, considerable gain in length may be obtained by this maneuver of spermato-lysis.



Fig 5A



Fig 5B



Fig 6

F 5 A Ph t g ph m d p d m u l f m b b bta d th t t whi h tro g h
p t l ft d q t l y m b l g d pla g gw l t t t h d t th t ca lb m w p ed thro gh
t t t th se t m B Th lt y ft p th t m d f t ed t th th gh H aft
t F 6 A f ly t f t y p t p t l t h d y d bl l t b ed b ed
thu ph t g ph

occurrence of hernia brings them to the surgeon. In patients past 30 years of age in whom the undescended testis is often completely atrophic the same indication does not exist for anchoring the testis in the scrotum as obtains in younger individuals. It has been demonstrated for the rabbit and guinea pig at any rate that one sixteenth of a normal testis suffices to permit the development of the secondary sex characters.

The size of the testis is a fair criterion of how it will react to being placed in its natural habitat. A small atrophic organ from which the germinal cells have disappeared will probably exhibit no growth with which in a testis of fair size in a patient past puberty it may be assumed that the young germinal epithelium capable of elaborating the mature germinal cells still survive. In the prepuberty testis it must be recalled that the normally descended testis is also atrophic to palpation.

The development of the prepubertal orchopexy and is closely linked with the name of Bevan. The modern operation as it is known today is largely the result of his efforts. He has stressed particularly the fact that the separation of the vaginal processes from the other elements of the spermatic cord combined with the removal of the congenital folds and ill-shapen ilizations of the testis that in most cases it may with ease be placed into the scrotum. A particular point of concern however is that such a testis stripped of the cremaster muscle and all the fascial covering frequently retracts. Veils are elastic and no longer than they have to be and undoubtedly play a significant rôle in the subsequent leakage

of the testis. At the time of operation the testis stripped of its fascial coverings may frequently be placed with comparative ease on the thigh below the bottom of the scrotum. On the completion of the operative procedure the testis lies free at the bottom of the scrotal sac but a few days later when the wound is inspected retraction of the testis out of the scrotum may frequently be observed. The scrotum also may play a part in this subsequent elevation. It has been operated upon several cases by Bevan's technique placing the testis in the bottom of the scrotum freed from all fascial connection the testis remains suspended by vessels and as desired alone. Much to my chagrin and disappointment the testis has later become elevated to a position high in the scrotum. Figure 5 illustrates such an occurrence. Later I was prompted to fix the testis to the bottom of the scrotum and passed a long suture of linen placed in the tunica albuginea through the bottom of the scrotum in a choring the tract in suture to the mid thigh by adhesive tape to hold the testis on the stretch. The thigh was kept extended for weeks after which time the tractionure was cut and the patient was allowed up. The immediate result was better on the whole than when no traction was used at all. An examination five years after a lapse of time revealed the fact that the majority of them had retracted into the upper abdominal region (Fig 6) and compared with the other testis indicated that it failed to show the same growth which occurred in the normal contralateral testis. I recently performed an operation of my wife's which might be described as a

a thick insulating layer of fat exhibits between the skin and the tunica vaginalis communis a thin layer of fat. In some of the earlier cases in which I employed this method, this fat was dissected free from the skin resulting in a very insecure attachment of the skin of the scrotum to the thigh. The blood supply of the skin, as is well known, ramifies in this fat, and the detachment of the fat from the dermis would vitiate the healing in skin wounds anywhere. In effecting the union between the skin of the scrotum and the skin of the thigh this point should therefore be kept in mind. In making the incision into the scrotum this should extend down to, but not through the tunica vaginalis communis, this permits of a satisfactory suture and a firm union between scrotal and thigh skin. It is very important that the leg on the side operated upon be maintained in acute flexion for at least a week to preclude tension on the cutaneous union of scrotum and thigh. The remote results in cases in which this method has been practiced after detachment of the scrotal attachment to the thigh are uniformly good. The testis maintains a low scrotal position and the testis exhibits growth commensurate with the normal.

TECHNIQUE OF OPERATION

Spinal anesthesia is employed in adults and an ethylene ether sequence in children. An oblique inguinal incision is made from the tubercle of the pubis extending about an inch beyond the location of the internal abdominal ring. Not infrequently the testis is found just emerging from the external ring, in which event it must be carefully isolated before the external oblique aponeurosis is split. When the leaves of the external oblique aponeurosis are drawn aside and the inguinal canal is fully exposed, the testis usually comes into view (Fig 7A). Occasionally when the testis is intra-abdominal it is not observed until the peritoneal tunic is isolated and pulled medially by a retractor.

After the spermatic cord is gently freed and isolated from the adjacent tissues, the testis is pulled upward putting the gubernaculum on tension. This attachment of the testis to the scrotum is then divided (Fig 7B). Before division of the gubernaculum, however, it is well to ascertain whether or not the epididymis and testis are widely separated as occasionally occurs. It is a good plan at this stage to pass the fingers into the scrotum to stretch it out, and a large gauze sponge is left

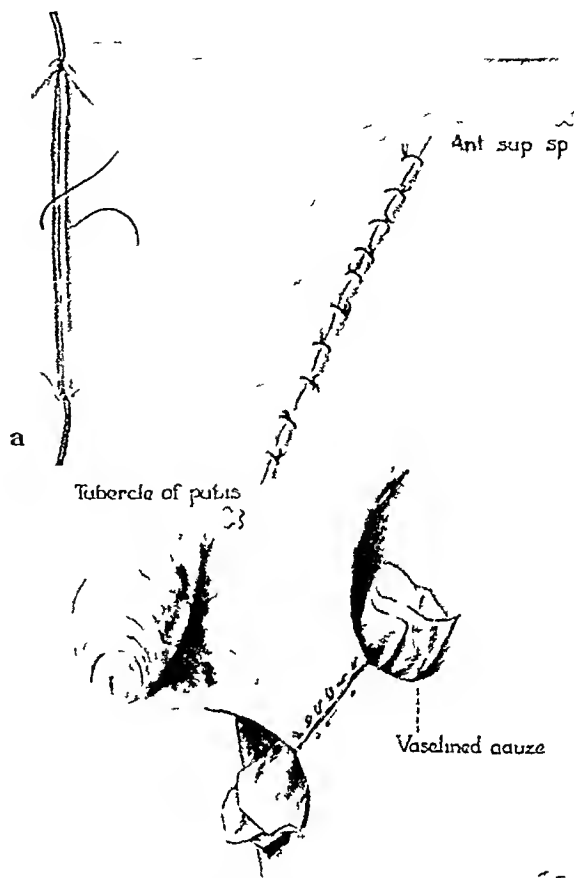


Fig 12 The procedure completed. The thigh should be kept acutely flexed over a pillow for a week after operation.

in the scrotum until the testis is fixed *in situ*. The hernial sac is then identified in its antero-medial position in the spermatic cord. After incision of the anterior wall of the sac, saline is injected beneath the posterior wall as suggested by Bevan to permit of easy mobilization. In young patients who have not had an actual hernia, the hernial sac is usually paper thin and must be handled with extreme gentleness to obviate tearing of the sac. I usually delay ligating the hernial sac until the spermatic vessels have been sufficiently mobilized to permit of easily placing the testis in the bottom of the scrotum.

The vas deferens is now identified and gently separated from the other components of the spermatic cord. Only rarely is it short. Simple division and ligation of the deep epigastric vessels will in such an event usually make the vas deferens long enough to reach the bottom of the scrotum.

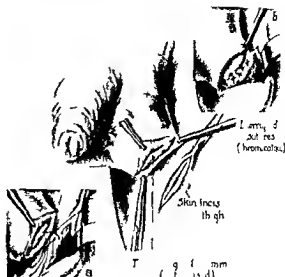
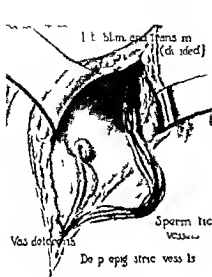


Fig 9

Fig 9. If the testis is to be brought to the thigh and the testis is anchored to the fascia of the thigh but still remains within the scrotum. The accompanying sketches make the details of the operation clear. These drawings are from sketches made by Miss Jean Hirsch of the Medical Art Department of the University. The details of the operation are from sketches made by Miss Jean Hirsch of the Medical Art Department of the University. The details of the operation are from sketches made by Miss Jean Hirsch of the Medical Art Department of the University.

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Fig 1. F. h. t. es. f. h. t. g. t. pl. ed. th. t. ca. lb. ga. a. d. b. ght. d. wa. th. gh. th. t. n. g. l. comm. is. d. f. t. ed. t. th. fascia. f. th. thigh.

m. If the testis is to be brought to the thigh and the testis is anchored to the fascia of the thigh but still remains within the scrotum. The accompanying sketches make the details of the operation clear. These drawings are from sketches made by Miss Jean Hirsch of the Medical Art Department of the University. The details of the operation are from sketches made by Miss Jean Hirsch of the Medical Art Department of the University.

From the external genitalia are fairly well developed. After a period of 4 months or more the skin attachment of the scrotum to the thigh is secured. A subsequent study has indicated that these testes tend to remain in the low scrotal position and exhibit growth in agreement with that of the normal. In this method the skin attachment could remain throughout life if the patient desired. However, the desire on the part of the patient to preserve the normal cleanliness of the external genitalia usually urges him to have this attachment removed. There is a point in the performance of this procedure that presents a few difficulties. The skin of the scrotum though not presenting



Fig 14A

Fig 14B

Fig 14C

Fig 14 A, Boy of 15, photograph on admission, B, After replacement of both testes from retroperitoneal

region into scrotum C, 3 years later Both testes in scrotum, left in midscrotum and not as large as right

the operative procedure a strip of vaselined gauze is drawn beneath the new cutaneous union

After ligation of the hernial sac, the hernioplasty is completed by approximating Poupart's ligament and the conjoined tendon and internal oblique over the cord Transplanting the cord, as in the ordinary Bassini operation, lengthens the path of the spermatic vessels and shortens the cord and should be omitted The external oblique aponeurosis is approximated by interrupted sutures as in the usual hernia operation and the skin is brought together with interrupted sutures of linen

Division of the vessels in the spermatic cord leaving only the artery accompanying the vas deferens is to be condemned Experimental as well as clinical study of the instances in which such a procedure is used shows that almost invariably atrophy occurs The interstitial cells also disappear Such a testis is no longer a gland but is only scar tissue

RESULTS

Among the 30 patients¹ upon whom I have operated for undescended testis, one was excised because the patient demanded excision In 2 other boys each aged 8 years, a testis was excised because it was found to be only a mere vestige at operation that could not even be definitely identified as testis In both instances a normal vas deferens and spermatic vessels were present

Histologically, no evidence of seminiferous tubules was discernible in one and in the other only a few tubules were made out, in one the epididymis was histologically normal, in the other ducts also appeared abnormal These observations are such an unusual occurrence in my experience that their description will be made the subject of a special report One of these boys had bilateral failure of descent, and the other testis appeared quite normal and was anchored in the scrotum²

One was placed into the retroperitoneal space because the shortness of the vessels after most thorough mobilization precluded anchoring the testis in the scrotum The vas deferens was divided and ligated to preclude retroperitoneal extension of infection should an epididymitis occur later in life The division of the vas deferens of course, causes no demonstrable change in the histology of the testis In this respect the testis differs from the other glands in which ligation or division of the excretory ducts almost invariably results in atrophy In only 2 instances in this series was the vas of inadequate length Simple division and ligation of the deep epigastric vessels sufficed to make the vas in each instance adequately long A hernial sac was present in all instances in this series, in one case, however, the sac was obliterated at the upper end In several instances no hernial content had ever become engaged in the sac In 6 of the 30 instances the testis and epididymis were more or less separated

¹Five of these patients were operated upon since this paper was presented February 6, 1930

²It may be repeated here that the size of the testis is a fair index of its histology bearing in mind of course that the testis exhibits but very light growth from birth to puberty

which the testis is temporarily placed in the thigh and later returned to the scrotum. In a few foreign clinics, it has been my good fortune to see the remote results following the establishment of an artificial synorchidism (Mauclaire's procedure) in which the imperfectly descended testis is brought through the scrotal septum and anchored to its fellow. Many who have practiced this procedure express complete satisfaction with the results obtained with method.

SUMMARY

The imperfectly descended testis is aspermatic because of its position. Prior to puberty the undescended testis is in every respect much like its normal fellow in the scrotum. The scrotum serves as a thermo-regulating mechanism, and in the adult only a scrotal testis is normal. The undescended testis is more likely to become malignant than is the normally descended one and scrotal fixation does not diminish this increased predisposition to malignancy. The undescended testis, however, is not a precancerous lesion and

it is true that testicular malignancies are infrequent.

The procedure of election in the treatment of failure of descent is placement of the testis into the scrotum without injury of the testicular blood vessels. Adequate mobilization of the vessels of the testis (spermatolysis) is a significant and essential factor for the success of the procedure. In the operation of orchiopexy, temporary scrotal anchorage is an important detail of the technique. Without adequate scrotal fixation retraction occurs, and growth of the testis commensurate with the normal does not obtain. A method to secure this end is described. The optimum time for the performance of the operation is between 8 and 11 years, to insure a good functional result it is important that the operation be done before puberty.

NOTE—A fairly complete bibliography is to be found in my paper "The Undescended Testis, an experimental and clinical study." Ph. D. Thesis, University of Minnesota, December, 1925, also reprinted in the *Archives of Surgery*, March, 1927.



Fig 5



Fig 6A



Fig 6B

Fig 5 By fig 5 ft dt hm t fth scrot l
tt hm t. Th test th l perated po h gs
lw th th mally pl ed sc tal test th l ft

Fig 6 A O h p y f gu l t u Ap
f gauz h b draw be eath th scrotal d th t
t co j t B Eighteen m th lat

When ordinarily the epididymis caps the testis such a separation may also be observed in the normal but not with the same frequency as it occurs in the undescended testicle.

Seven patients in this series were more than 15 years of age. One was 28, another 26, 2 were 25, were between 14 and 15 years of age. The others were under 13, the youngest was 3 and the next youngest 7. The larger number were between 8 and 17 years of age. Five of these had bilateral failure of descent. One of these both testicles were intra-abdominal but with persistent effusion of the testes. The other four were in the inguinal position (Fig 4). Examination 3 years later shows the result to be quite satisfactory. The right testis lies in the scrotum and of normal size. The left, some of these had a large size as the right.

In most of the bilateral cases both sides have been operated upon at the same sitting. One instance of unilateral failure of descent, however, the vessel proved of inadequate length after thorough mobilization of the testis as fixed high in the scrotum and later anchored at a satisfactory position at the bottom of the scrotum.

Of the 20 cases operated upon by the technique described in this paper, a uniformly good result has been obtained in almost every instance. In a few of the early cases in which fixation of the thigh was not strictly observed and in which the approximation of the skin of the thigh and scrotum was imperfect because of the separation of the thin layer of fat from the scrotal skin, effecting the suture early detachment of the testis occurred, permitting of retraction of the testis into the upper scrotum.

The experience gained in the operation of orchopexy in this series of cases has demonstrated to my own satisfaction that protracted anchorage of the testis is an important and significant detail for the complete success of the procedure. Only a testis which remains low in the scrotum will inhibit the growth of which the normal testis is capable.

It has been my privilege to see the happy end results in other types of operative procedure that I have had occasion to practice. Herbert Meyer, a recent paper has indicated the plan of procedure obtained by the Torek operation in

strongly in favor of immediate amputation Billroth busied himself for a time with it. He considered the cause to be the decomposition of the mortified elements occurring in the disease. These products apparently were able to diffuse so rapidly that he thought that they might be caused by the action of some ferment. Gurlt discussed it in his monumental work on bone surgery (1862).

In the American Civil War, there is no record of gas gangrene as such. In fact, Keen, who served as a military surgeon, stated that he never saw a case. It was, however, observed in the Franco-Prussian War. Wyatt observed it at the siege of Paris. Frey mentioned it as occurring in Belfort (Triaud). Passow declared that it was discussed at a meeting of the German military surgeons in Orleans.

With the appearance of the "Bacteriological Era," the organisms found associated with the disease were investigated by various workers. Pasteur discovered the vibron septique, Novy the bacillus oedematis, Koch the bacillus of malignant oedema, and Welch the gas bacillus (bacillus welchii). Fraenkel, von Hibbler, and, more recently, Weinberg have been outstanding workers in this field. The clinical aspect of this disease has been investigated and described by Stolz (1902), Stewart (1905), Cramp (1912), and Simonds (1915).

During the World War great interest was aroused in the disease and the literature which appeared during the years 1914-1918 was prodigious. Among a great number of papers perhaps the best articles are the Surgeon General's Report, (U.S.A.), the Report of the Medical Council of Great Britain, and Coenen's monograph on "Der Gasbrand."

ANALYSIS OF CASES OF GAS GANGRENE IN CIVIL LIFE

A series of 607 cases¹ occurring in civil life² have been collected and subjected to analysis.³ Obstetrical infections have not been included, although there have been a fair number of these reported in the literature (Bruett, Little, Nurnberger, and Ingles among others).

Only those reported subsequent to the Lister era are taken. In his excellent monograph on this subject Triaud has 123 cases before 1883.

¹ It must be realized that there are many more cases occurring throughout the world than are reported. This series is perhaps not a fair cross section because of the human tendency to report the bizarre and apparently unusual conditions.

² Gas gangrene is not listed as a cause of death in the Bureau of Census Vitality Tables of the Registration Area in continental United States.

³ The total number of cases previously reviewed were Stewart 61 cases (1905), Cramp 157 cases (1912), Simonds 123 cases (1915). Each included in his series the work of his predecessors. The writer has added one more case.

These have been omitted. Neither have cases been counted which fail to contain clinical data. Sordelli, of Argentina, for example, mentions that he had seen 11 cases, but discusses them from a bacteriological aspect. Neither are those cases included in which the diagnosis was made after death or found at the autopsy table. This rules out the possibility of bacillus welchii developing when decomposition commences. Several other quite questionable cases are also omitted.

TABLE I—MORTALITY

	Cases
Grand total studied	607
Total recoveries	(50 3+6) 291
Total deaths	(49 7-6) 287
Total with known outcome	578
Total with result unknown	20

Mortality. The American Expeditionary Force in France had a death rate according to The Surgeon General's Office of 48.52 per cent. Of the 128,265 wounds of the soft parts recorded 1,389 developed gas gangrene, 1.08 per cent. This excluded chemical warfare gases. There were 674 deaths.

The official British Expeditionary Force report gives an "Incidence of 1 per cent" which constituted a serious loss on account of the high mortality of 20 to 50 per cent. The number of cases varied in the big pushes, and when the wounded were not treated quickly, it was of course higher."

TABLE II—SEX INCIDENCE

	Total	Per cent
Males	305	
Recovered	201	50.9—
Died	194	49.1+
Females	60	
Recovered	33	47.8
Died	36	52.2
Unclassified	114	
Recovered	57	50.0
Died	57	50.0
Unclassified as to sex or to result		20

TABLE III—AGE INCIDENCE

Age	Total	Recovered No. Per cent	Died No. Per cent	Result not stated
0 to 9	34	18 58.1—	13 41.9+	3
10 to 19	77	43 58.1	31 41.9+	3
20 to 29	80	48 55.2	39 44.8	2
30 to 39	76	40 55.5	32 44.5—	4
40 to 49	62	20 33.9	38 66.1	4
50 to 59	46	10 43.2	25 56.8	2
60 to 69	29	8 27.6	21 72.4	0
70 to 79	7	4 57.0	3 33.0	0
80 to 89	0	0	0	0
Not stated	187	92 52.3	84 47.7	11
Totals	607	302	286	20

GAS GANGRENE IN CIVIL LIFE

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GAS gangrene assumed great importance during the World War because of its great frequency. However, it is a disease which has been known for many years in both civil and military practice. Hippocrates' written of a case of gangrene though it is not clear that it was of the emphysematous type, said Celsus that Thales commenced to experience pain in his foot in his great toe. He went to bed the same day. He had a slight chill, some nausea, and then a little fever. He became delirious during the night. On the second day there was swelling of the entire foot and over the whole ankle which was a little red and tender. The exudate was present in black blebs and he had a great fever. The skin on the leg was completely out of his head. There were frequent evacuations of bilious matter. He died the second day after the onset of the illness. Celsus is thought by some to have known of the occurrence of gas gangrene in pregnancy for in his chapter on the extraction of the dead fetus we find "It may so happen that the child may be distended with a humor from which there flows a fluid with a foetid odor."

Following these early writings there is a long period during which the disease seems not to have been recognized. Avicenna, Guy de Chauliac, J. de Vigo, and Ambroise Paré do not refer to it (Trifaud). But in Fabricius de Hilden's work (*Opera Omnia*, Frankfurt, 1746) we find mention of gas gangrene. It is my belief he says that the principal cause of this terrible illness is some venomous humor which Nature has driven into these people.

Quercy in 1745 in a chapter on Gangrene of putrid dissolution of the humeral mass gave Peyronnie the credit of being the first to describe and to furnish exact observation on gas gangrene and spoke of "The subcutaneous emphysema, the erysipelatous color of the skin and the rapidity of death." We find that D. la Motte in 1777 published two observations which have been accepted by some as possible cases of gas gangrene. In 1785 Thomas Kilian in a paper called it gas gangrene of the emphysematous type.

Early in the nineteenth century Larrey during the Napoleonic wars seemed to have known this infection. In some of his observations he spoke of the rapid progress of traumatic gangrene which in a few hours spread from the injured limb and

was often fatal in less than 24 hours. Boyer in

1814 mentioned its occurrence in fractures and also spoke of the rapidity of death while Velpeau in 1829 stressed it as a complication of fractured limbs and considered the emphysema of great significance. In his experiences death was the outcome in many cases. Dupuytren in his lectures under the name of spontaneous emphysema described a condition occurring in trauma resulting in rapid decomposition and in 1836 we find Martin de Baas published a case of foudroyant gangrene which followed a crushed foot and in which death occurred in 12 hours. Malgaigne recalls a case of rapid termination after emphysema complicating a fractured limb. He looked for the real cause. I think he declared

that there occurs under the influence of shock and stupor a special change which attacks life just as an electric light will kill the sperm in an egg and which will destroy the vitality of a blood clot without any appreciable changes in the appearance. For the first time the gas escaped from the emphysema as analyzed. It was found to be inflammable and it constantly showed the presence of hydrogen sulphide. Trifaud states that Renault and Chauveau were among the first to create gangrene in experiments upon animals.

At the meeting of the Academy of Sciences on October 11, 1849, Chassagnac asserted that certain gangrenes with emphysema should be considered as having a position far in excess of the mechanical injury. He described 4 cases the next year which showed what he called *empoussonnement traumatique*. Maisonneuve reported to the Academy at a later date (September 1, 1853) 2 cases of gas gangrene and declared that he established a certain variety of traumatic gangrene to which he gave the name of *gangrene foudroyante* in which first putrefying gases developed in the interior of veins during life and second that this gas circulated in the blood and caused a fatal poisoning. Later on de Lelong published the doctrine of *pseudohæmaturia* (*pseudohæmaturia*) he considered this as a variety of septæmia.

During the Crimean War Pirgoff with the Pussan and Sallero of the Allied Forces both noted this condition and wrote about it.

Dubuc emphasized the idea that this autoinfection is always fatal and declared himself

tribution Cases following operative procedures and injections have often been of unusual interest and so have been reported for that reason

TABLE IX—GAS GANGRENE
FOLLOWING OPERATIONS

	Cases
Appendectomy	8
Genito urinary operations	5
For neoplasm	4
Aneurisms	3
Miscellaneous (rectal, suspensions, etc.)	17
Not definitely stated	8
Hernioplasty	3

TABLE X—SITE OF INJURY

	Cases
Head	8
Neck	5
Trunk	76
Arm	50
Elbow	5
Forearm	47
Wrist	2
Hand	14
Thigh	65
Leg	150
Knee	2
Foot	32
Scrotum	8
Perineum	4
Listed as "upper extremities"	5
Listed as "lower extremities"	8
Listed as "extremities"	61
Not stated as to location	67

TABLE XI—SUMMARY

	Cases	Approximate percentage
Listed as "extremities"	61	11.3
Upper extremities	121	22.6
Lower extremities	257	47.6
Trunk and genitalia	88	16.3
Head and neck	13	2.4
Total known	540	

Treatment In Table XII are listed the methods of treatment and their results

The cases which were treated with pure oxygen, charcoal, rivanol, Pilcher's solution, etc., are insufficient to make any fair analysis

Relation of bacillus welchii to appendicitis There are many conflicting ideas as to the importance of bacillus welchii in appendicitis. Jennings stresses the fact that it may be of value to employ serum in acute cases with localized, spreading, or general peritonitis. When a smear is found to be positive for bacillus welchii he recommends and uses intravenous serum. He also favors this in gunshot wounds of the bowel. On the other hand, Simonds and Dudgeon with Sargeant, do

TABLE XII—TREATMENT

	Totals	Recover ed		Died		Not
		Cases	Per cent	Cases	Per cent	sated
Amputations	128	71	58 7	50	41 3	7
Incision and drain- age (including de- bridement)	125	57	47 1	64	52 9—	4
Amputations plus serum	40	19	47 5	21	52 5	0
Amputations plus in- cisions	38	28	77 7	8	22 3—	2
Serum	22	15	68 2—	7	31 8+	0
Serum plus incisions	22	17	81 0—	4	19 0+	1
Amputations plus in- cisions plus serum	15	7	50 0	7	50 0	1
Miscellaneous (ribre sections, charcoal, etc.)	9	4	44 4—	5	55 5	0
Number not stated and not surgically treated	208	73		121		14
Totals	607	291	50 3	287	49 7	29

Irrigations

Irrigations	Recovered		Results		Un- known			
	Cases	Per cent	Cases	Per cent				
Hydrogen peroxide	47	33	70	2	14	29	8	0
Dakin's	37	24	66	6	12	33	3	1
Dakin's and hy- drogen peroxide	4	4			0			0

not believe that anaerobic bacteria play such an important part. The two last argue that if the bacillus aerogenes capsulatus were prevalent, emphysematous gangrene of the bowel would be seen very much more frequently in people dying of appendicitis.

X-ray diagnosis The fluoroscope and X-ray are valuable early instruments of diagnosis. Indeed, Savill goes so far as to say that the roentgen-ray picture will show the various kinds of gas. She declares that bacillus welchii and vibrio septique (among others) have their peculiar diagnostic characteristics.

Use of oxygen Oxygen has been tried in several ways: (1) by allowing the gas to penetrate the wounded tissue by inserted tubes, (2) by injecting the oxygen into the wound and into the tissues in front of the progressing infection. The German War surgeons declare this latter dangerous and cite cases of fatal air embolism. They (Frankenthal, Gaertner, Simmonds) warn against this.

Relation to diabetes It is of surgical interest to bear in mind that glycosuria may be present (Rose), and that cases have been known to have followed amputation for diabetic gangrene (Linton).

A list showing authors' names and number of cases collected from the literature is appended

Symptoms The two main symptoms of gas gangrene are crepitus and discoloration. Discoloration was noted in 226 cases and crepitus in 235 cases as shown in Table IV.

TABLE IV—SYMPTOMS

			N	Ap	pe	m
Discoloration	ted	th first d y	8	36+		
Discoloration	ted	the o d d y	86	33+		
Discoloration	oted	the third d	27	+		
Discoloration	ted	th f th d y	3	3+		
T t l			6			
Crepitus	ted	th fir t d	6	5+		
Crepitus	oted	th d d y	93	30+		
Crepitus	ted	n th th d d y	37	5+		
Crepitus	ted	n th f th d y	4	9+		
T tal			35			

Bacteriological examination Table V shows the result of the bacteriological studies which were made and which were not very accurate. In many cases the bacillus welchii was the only organism that was looked for and the only one that was cultured. Doubtless there were many more mixed cultures present.

TABLE V—ORGANISMS FOUND

	Case
Bacillus welchii	3
Organism described	3
Bacillus welchii plus streptococcus	3
Bacillus fusiformis	3
Bacillus welchii plus streptococcus plus diphtheria	6
Bacillus welchii plus cocci	3
Streptococcus	3
Bacillus welchii plus miscellaneous	9

Fractures The relation of gas gangrene to fractures is well known. In the American Expeditionary Forces in the 25,272 cases which included bone fracture there were 1,329 cases of gas gangrene.

In this series of 607 cases there were 227 bone fractures, 143 of which were compound. It is thought by some that the calcium salts liberated by the disintegration of devitalized bone substance tends to lessen the resistance to anaerobes. Certain investigators have found that the presence of certain calcium salts aids in the production of gas gangrene. Whatever the reason may be, traumatized bone itself causes marked injury of the body substance and adds to the damage already done. The fact that the bone fragments may be deeply embedded in the middle of the muscle away from the air makes for a favorable focus.

TABLE VI—RELATION OF GAS GANGRENE TO FRACTURES

	T	I	her	Com-
	fractures			pound
Skull				
Shoulder				
Humerus				
Radius				
Ulna				
Radius				
Femur				
Tibia				
Fibula				
Tibia				
Fibula				
Foot				
Hand				
Spine				
Pelvis				
Femur				
Tibia				
Fibula				
Radius				
Ulna				
Fractured				
Tibia				
Peroneus				

Seasonal occurrence Table VII gives the number of cases by months.

TABLE VII—SEASONAL OCCURRENCE

	N	P	T	on
January	38	8	July	3
February	3	9	August	5
March	37	5	September	6
April	8	5	October	3
May	3	9	November	3
June	3	9	December	9
Total known				36
Not stated				

The condition is found in all parts of the world. Cases have been reported from most of the countries of Europe and North America, from Russia, Turkey, Africa (Algeria), South America (Argentina and Uruguay), Australia, New Zealand, Oceania, and the Philippine Islands.

TABLE VIII—PREDISPOSING CAUSE

	Case
Gunshot wound	53
Fall	54
Vehicle (riding)	53
Operation	45
Etymology	5
Refractured	4
Fracture	7
Gunshot of diabetic mellitus	
Abscess	7
Gunshot of diabetic mellitus	7
Miscellaneous (etiology)	5
Not stated	4

Predisposing causes Table VIII is probably not an entirely accurate picture as to the causal dis-

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SUMMARY

1 It is h wn that gas gangrene is as kno n long before the m dle of the last century when it was agn brought to modern attention by Saller n Mas oneuve a d others

2 Six hundred a d seven ca es occurrn from the begnng of the post Lister pe od to the present (1930) ha e been c llected an f subjected to analysis This des n t include obstetncal cases

3 The mortality of these collected ca es as 49.7— per cent and that f the American Expe l tory F ree in France as 48.52 per cent

4 There were 227 fractures f which 143 were compound

5 The the apy is disc ssed The sm ll num ber of cases prevents a y defnite conclus

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A COMPARATIVE STUDY OF TUBERCULOUS LESIONS OF THE UROGENITAL TRACT

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ALTHOUGH tuberculosis of the urogenital tract is commonly thought to be well understood, there are perhaps still some aspects from which new information of practical value may be derived. In meditating on the problem we have been impressed with the following facts: first, the difficulty of arriving at an absolute diagnosis clinically, second, the difficulty of arriving at a complete diagnosis from either surgical or postmortem material, and third, the need for a correlated study of clinical, pathological and bacteriological findings in genito-urinary tuberculosis. By such a procedure only will we be able to form a correct opinion of the onset, progress, and termination of the disease in all its manifestations.

Urologists generally possess well crystallized ideas regarding genito-urinary tuberculosis that is commonly met with. The general opinion seems to be that the disease is most commonly hæmatogenous, involving one kidney first or one epididymis with a spread from these points to other parts of the tract. Variations from these routes occur, but are considered of minor importance. Statistics on the subject may be of some help.

The incidence of genito-urinary tuberculosis depends upon the type of patient. In pulmonary tuberculosis, Huebner states that 3 to 5 per cent reveal genito-urinary lesions while 50 to 70 per cent of extrapulmonary tuberculosis have urogenital tuberculosis. Fowler and Godlee found genito-urinary involvement in 5.27 per cent of pulmonary tuberculosis, Krzywicki 5 per cent, Hesse in over ten thousand tuberculous cases found only 2.13 per cent with genito-urinary tuberculosis. Of the various parts of the genito-urinary tract involved, Scott quotes various authors to show that about 60 to 75 per cent of genito-urinary tuberculosis involves the prostate but is mostly secondary to infection elsewhere in the genito-urinary tract. The kidney and epididymis perhaps will show a similar percentage although no definite figures are given. Relative to pulmonary involvement in genito-urinary cases, Scott cites references to show that from 27 to 80 per cent of genito-urinary cases have pulmonary disease. Perhaps all who do not have it will develop it before death if they die from this disease.

Of all the forms, renal infection is considered to be of the most importance. This is perhaps due to the fact that it is the earliest identified. A few opinions will be cited on this phase of the subject.

Hammond considers that 92 per cent of renal tuberculosis appears first in one kidney by the hæmatogenous route. It begins either in the apex of the papillæ or at the cortico-medullary junction. It may spread to the other kidney by vesical or ureteral extension. Pathologically, there are three types: the ulcerocavernous with constant urinary findings and no enlargements, the hydronephrotic with enlargement and intermittent urinary findings, and the caseous in which no urinary findings may be present. Although Vaccaro considers the possibility of a tuberculous genito-urinary infection arising from bacilli that have passed the respiratory passages without lesion, the most likely origin is from some remote focus of infection. Nitch divides renal tuberculosis into two groups, surgical and medical, depending on the origin. The former arises from some latent focus, while the latter arises from some other massive involvement elsewhere, is bilateral, and is at no time surgical. He states that many times the surgical variety is also bilateral from its inception as animal inoculation will frequently reveal. Animal inoculation, however, is not entirely dependable, as shown by Morse and Braasch. They found that the guinea pig test was negative in 17.7 per cent of proved cases of renal tuberculosis and positive in 18 per cent of kidneys that were thought to be normal mates to tuberculous kidneys. They agree with Medlar and Sasano that excretory bacillosis is negligible and attribute the positive findings to a possible ureteral "reflux."

Relative to the early symptoms of renal tuberculosis, Beer summarized 100 cases and found that 9 to 12 months elapsed from the beginning of the typical symptom complex before the condition was diagnosed. It is more in males than females, more on right than left, nearly always hæmatogenous, begins in papillæ and extends to pelvis, ureters, and bladder, sometimes causing stricture with resulting hydronephrosis and secondary infection. Runeberg analyzes 213 cases of renal tuberculosis, 123 of which had a nephrectomy.

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TABLE I—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—103 PAIRS OF KIDNEYS

Pathology	Number	Percentage
Generalized miliary (bilateral)	1	1 0
Localized miliary (bilateral)	6	6 2
Hyperplastic (unilateral)	1	1 0
Ulcerative (1 unilateral and 1 bilateral)	2	2 0
Total	10	10 2

TABLE II—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—70 PROSTATES

Pathology	Number	Percentage
Miliary and caseous nodular (2 primary, 3 secondary)	5	7 1
Hyperplastic nodular (primary) (positive also in kidney)	1	1 4
Total	6	8 5
Primary in prostate alone	1	1 4
Primary in prostate, but secondary in vesicles, bladder, and kidney	1	1 4
Primary hyperplastic	1	1 4
Total primary	3	4 2
Secondary in prostate but primary in epididymis, vas, and vesicles	2	2 8
Secondary in prostate but primary in epididymis, vas, and vesicles but also local miliary in kidneys	1	1 4
Total	3	4 2

the only difference will be in the relatively rare organs possessing isolated microscopic tubercles In this type of tubercle we should expect to obtain a lower result than did Medlar

In Table I is one case of generalized miliary tuberculosis in which the process was extended to both kidneys Six other cases had miliary tubercles scattered through both kidneys that was not a part of a generalized tuberculosis but of a localized process One patient had a unilateral hyperplastic process that is shown in Figure 1 This will be described separately as will the bilateral ulcerative kidney involvement shown in Figure 2

In Table II are charted various forms of prostatic involvement This makes a total of 8 5 per cent of all male cases posted The hyperplastic nodular is the same case as shown in Figure 1 The primary tuberculosis in the prostate alone was an isolated nodular tubercle found in a terminal case of pulmonary tuberculosis The other primary cases shown in Figures 2 and 3 will be given in the case summaries

Secondary involvement of the prostate perhaps occurs in all advanced disease of other parts of the genito-urinary tract

TABLE III—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—50 EPIDIDYMITIDES VASA, VESICLES

Pathology	Number	Percentage
Primary caseous	4	8 0
Secondary, primary in prostate	1	2 0
Secondary in vesicles, primary in prostate	1	2 0
Total	6	12 0

TABLE IV—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—70 BLADDERS

Pathology	Number	Percentage
Ulcerative (all secondary)	3	4 3

In Table III are charted the findings in the epididymis, vas, and vesicles In the epididymis we believe exists one of the most common sites of infection of the genito-urinary tract, yet it may not be as exclusive here as is commonly thought

The bladders shown in Table IV and in the females appeared to be secondary to involvement of other portions of the genito-urinary tract

In Table V are the figures on the kidneys from 71 female patients The kidney involvement is about the same in formation and type as in the male with the exception of miliary abscesses that were found in 5 cases These, we feel, were very early tubercles that have not developed specific character Why these should show more in females we cannot answer The hyperplastic tuberculosis was in a colored woman having a disseminated nodular tuberculosis throughout (tuberculomata)

In Table VI besides the bladders, already mentioned, are the findings of the other female genital organs Up to the present time we have had only one typical case of tuberculous endometritis This is not included in the table but has been a recent finding Table VI shows only one case having a slight involvement of the endometrium, and another having a superficial miliary process on the peritoneal surface as the part of a generalized process

CASE REPORTS

CASE 1 A unilateral hyperplastic process in a white American having a disseminated large nodular tuberculosis (tuberculomata) in all the organs The kidney and prostate are shown in Figure 1 The characteristic picture microscopically is a diffuse epithelioid and fibrous infiltration with many granules and cocci present

CASE 2 C P, No 24732 The essential points of the history are that at the age of 12 years, patient stated that he fell injuring his scrotum and penis Five years later hematuria occurred lasting only half a day The following year hematuria occurred again Since then it has occurred about four times at irregular intervals Last time was 2

There were symptoms for more than a year in 55 per cent before tuberculosis was suspected. The symptoms were mostly of an insidious nature such as frequent urination, lumbar pain was much less frequent and hæmaturia, pyuria and emaciation were rare. Incidentally he claims good operative results. Bugbee points out that the insidious nature may be due to a low grade infection capable of healing without detection. This may help explain the auto nephrectomies reported by Allemann, Wolff, Randall and others. Joly believes however that some so called spontaneous cures are due to a shutting off of the kidney by stricture but that the tuberculous focus persists. Fedoroff describes an atypical form of tuberculosis of the kidney in which there is an inflammatory reaction without tubercle formation.

Recently it has been recognized that the initial infection may occur in the prostate and spread from that point. Keyes, Walker, Koll, Barney and Crandon are a few who have reported isolated tuberculosis of the prostate. MacKenzie and Seng suggest that massive calcification of the prostate may be due to a calcified tuberculous lesion. Walker was able to find however but three acceptable cases in the literature. Nevertheless Barney states the scarcity of such cases does not represent a true percentage but a

deplorable failure on the part of surgeons to make proper examinations. Dillon reports a series of seminal tract tuberculosis and concludes that the initial lesion of such disease is more often in the pelvic glands than is generally considered. Nitch considers that the infection of the epididymis is most frequently secondary to an infection in the seminal tract or prostate but is the oldest lesion is located in the glans, minor and tendons thereto and the testis. Primary deposits in the globus major and testis are rare and perhaps always hæmatogenous.

Other clinical and pathological variations are not clearly defined or sufficiently systematized to be of use in applying therapeutic measures. For example the question of ascending kidney infection is little understood as is also the relation of hydronephrosis to renal tuberculosis. Regarding the former most authors consider that the ascending type of infection occurs occasionally but is not the rule. Hammond thinks that the second kidney is affected by ascending infection. Buerger, Oranson and Boeckel and Oberling report cases appearing to be ascending infections. Greifenstein and Kehl state that ascending infection occurs only in advanced tuberculosis of the bladder.

Hydronephrosis appears to be present in certain types of kidney tuberculosis. It is probably due to a ureteral stricture from a tuberculous process or associated infection. Cramin has made a study of these concomitant conditions and divides the cases into four groups: first unilateral involvement having hydronephrosis and tuberculosis; second unilateral hydronephrosis in one kidney and tuberculosis in the opposite kidney; third bilateral hydronephrosis and tuberculosis on one kidney; fourth both conditions bilateral which are obviously hopeless.

Perhaps the most important is the rôle of prostatic involvement in genitourinary tuberculosis. As mentioned above authors are beginning to recognize its importance but the relationship to the primary body lesion is not sufficiently understood. Neither do we know much of the relationship to kidney, bladder, ureteral and genital tuberculosis.

There is a definite trend recently to conservatism in the treatment of tuberculosis of the genitourinary apparatus. In spite of the favorable report of Runeberg who states that fully 80 per cent of the nephrectomized cases were rest of health. Young, Barney, Geisenstein and Kehl and others are more pessimistic. The proper follow-up study finds that the majority ultimately succumb to their tuberculosis. It is probable that there are many nephrectomies in bilateral disease or in disease of other portions of the genitourinary tract. Perhaps the absolute unilateral disease of the kidney or epididymis is not so common as thought or the diagnosis is made too late to forestall a spread to other parts of the genitourinary tract after operation.

In the subsequent report we shall cite cases and chart the results of autopsy finding in a series of tuberculous individuals and from these draw what conclusions we may. In doing this we are aware that such data must be interpreted continuously and conclusions which are drawn from the autopsies must apply only to patients dying of pulmonary tuberculosis, few of whom were other than cases of pulmonary tuberculosis from the beginning.

In this study we have classified 13 pairs of kidneys in male patients, 60 bladders, 50 female genital organs of the male, 71 pairs of kidneys of the female and 64 bladders, testis and ovaries. The discrepancies in the figures are due to the fact that autopsy section was not done on certain organs. As it is the sectioning was done every 5 to 6 millimeters and suspicious specimens were examined microscopically. This method is obviously not as complete as Medlar's although

TABLE I—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—103 PAIRS OF KIDNEYS

Pathology	Number	Percentage
Generalized miliary (bilateral)	1	1.0
Localized miliary (bilateral)	6	6.2
Hyperplastic (unilateral)	1	1.0
Ulcerative (1 unilateral and 1 bilateral)	2	2.0
Total	10	10.2

TABLE II—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—70 PROSTATES

Pathology	Number	Percentage
Miliary and caseous nodular (2 primary, 3 secondary)	5	7.1
Hyperplastic nodular (primary) (positive also in kidney)	1	1.4
Total	6	8.5
Primary in prostate alone	1	1.4
Primary in prostate, but secondary in vesicles, bladder, and kidney	1	1.4
Primary hyperplastic	1	1.4
Total primary	3	4.2
Secondary in prostate but primary in epididymis, vas, and vesicles	2	2.8
Secondary in prostate but primary in epididymis, vas, and vesicles but also local miliary in kidneys	1	1.4
Total	3	4.2

the only difference will be in the relatively rare organs possessing isolated microscopic tubercles. In this type of tubercle we should expect to obtain a lower result than did Medlar.

In Table I is one case of generalized miliary tuberculosis in which the process was extended to both kidneys. Six other cases had miliary tubercles scattered through both kidneys that was not a part of a generalized tuberculosis but of a localized process. One patient had a unilateral hyperplastic process that is shown in Figure 1. This will be described separately as will the bilateral ulcerative kidney involvement shown in Figure 2.

In Table II are charted various forms of prostatic involvement. This makes a total of 8.5 per cent of all male cases posted. The hyperplastic nodular is the same case as shown in Figure 1. The primary tuberculosis in the prostate alone was an isolated nodular tubercle found in a terminal case of pulmonary tuberculosis. The other primary cases shown in Figures 2 and 3 will be given in the case summaries.

Secondary involvement of the prostate perhaps occurs in all advanced disease of other parts of the genito-urinary tract.

TABLE III—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—50 EPIDIDYMITES, VASA, VESICLES

Pathology	Number	Percentage
Primary caseous	4	8.0
Secondary, primary in prostate	1	2.0
Secondary in vesicles, primary in prostate	1	2.0
Total	6	12.0

TABLE IV—MEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—70 BLADDERS

Pathology	Number	Percentage
Ulcerative (all secondary)	3	4.3

In Table III are charted the findings in the epididymis, vas, and vesicles. In the epididymis we believe exists one of the most common sites of infection of the genito-urinary tract, yet it may not be as exclusive here as is commonly thought.

The bladders shown in Table IV and in the females appeared to be secondary to involvement of other portions of the genito-urinary tract.

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CASE 2. C. P., No. 24732. The essential points of the history are that at the age of 12 years, patient stated that he fell injuring his scrotum and penis. Five years later hæmatuna occurred lasting only half a day. The following year hæmatuna occurred again. Since then it has occurred about four times at irregular intervals. Last time was 2



TABLE 1.—WOMEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—71 KIDNEYS

	P th l o g y	N	b e	P e r c e n t a g e
G	h i z e d m u l r y (b i l t r a l)			4
	T h t m m l d i s b e g t m			
	r u p t d d l p y m u d t t b e t			
	t h t p d f s h p e d t p l d			
	t p e n i t l t y			
Localized	m u l r y (b i l t r a l)	4	6	
H y p r t	t t b c u f			4
		6	38	
T t a l				
M l r y b	(p o b l y t b r c l)	5	7	

TABLE VI—WOMEN DYING OF ADVANCED
PULMONARY TUBERCULOSIS

Bj	dd		P h i g y	N t	P M
Ul	t				J
Ut ru	t bes			64	
G l u z e m l	ry (p m ry k d ey)			S	
L o c a l i z d	s a f p t m			S	

l d y f e d l i g h t f i l t t f t h p l b t
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 t h p l t t h m e d l t h r i g h t a h w i n g l e a y l a
 h y d r o p h d s i m m t r y h g t h r a t
 t f t b c u l (5) Th w t b r c l b l w
 t h l e s

A most important feature of this case is the fact that the pulmonary involvement seemed to be a very recent development without any calcified lesions. It is going too far at present to claim that tuberculosis was primary in the prostate. The primary lesion may have been in the lung with very slight involvement and the secondary lesion occurred in the prostate then the terminal disease occurred in the lung. This case is being studied more exhaustively.

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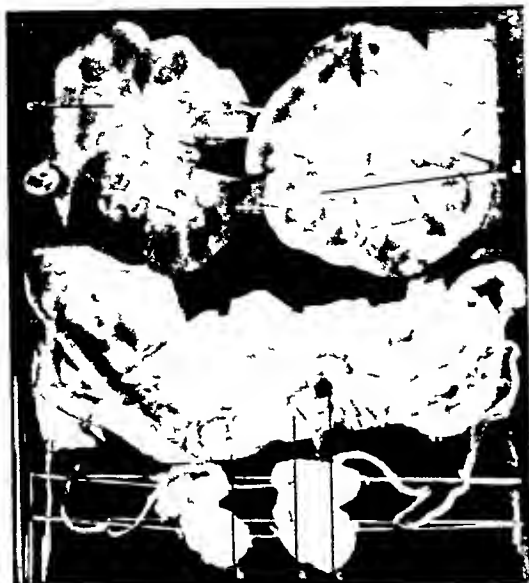


Fig 2 Primary genito-urinary tract tuberculosis of the prostate. Looking from the posterior part of the bladder *a*, Tuberculous prostate, right side *b*, Tuberculous seminal vesicle (right) *c* Non specific abscess in prostate *d*, Ulcerative tuberculous lesion in left kidney *e*, Slight hydronephrosis in right kidney



Fig 3 Primary genito-urinary tract tuberculosis of right epididymis, vas, and vesicles with ulcer in bladder at *a*

Cystoscopy was made with an irrigating cystoscope and it was possible to see that blood was coming from the left ureter. The hæmorrhage stopped temporarily but started after a few hours. The hæmorrhage was controlled fairly well for the first 24 hours once leaving a catheter in the ureter for 2½ hours. The urine was collected from both sides. The left side showed many tubercle bacilli while the right was straw colored and normal in appearance, and negative for tubercle bacilli.

Inasmuch as we were unable to control the hæmorrhage and inasmuch as the other side was free from tubercle bacilli, there was no other choice than to do a nephrectomy on the left side. She was taken to the operating room, and the kidney was quickly removed under nitrous oxide gas anesthesia. The patient was again transfused but had a stormy convalescence.

Pathology. The kidney showed two tuberculous lesions in the superior pole, one had broken into the upper calices while the other lesion was about 0.5 centimeter away from the pelvis of the kidney.

This patient never did make a complete recovery. Although her hæmorrhage was completely controlled she developed meningitis and died October 12, 1925. The important point in this case is the fact that she developed a hæmaturia on the opposite side, 10 days before her death and on urethral catheterization showed many tubercle bacilli by direct smear on examination.

It seems to us that this case makes a very good illustration of what we have to contend with in making a diagnosis of unilateral renal tuberculosis. Here we were dealing with a patient who had been handled by an excellent urologist. He

had made all tests possible for renal tuberculosis, including guinea pig inoculations and, as stated above, they were all negative. It was found that she had a tuberculous left kidney, and while there was no question as to the choice of treatment, a nephrectomy was done, but the same condition soon made its appearance in the other kidney. This case reveals clearly the necessity for a close study of the opposite, so-called "normal" kidney. This case confirms very well the work done by Braasch and others in which he found many patients who were found to have a tuberculous lesion on the opposite side after one kidney had been removed.

CASE 4. Mr G entered the Hospital February, 1927. He was 64 years of age and had all the symptoms of a patient suffering with a hypertrophied prostate. On rectal examination the prostate was found large and smooth and presented no nodules whatever. Cystoscopic examination showed the bladder to be normal with a few trabeculations present but otherwise resembling the bladder of a man suffering with an enlarged prostate. A blood chemistry examination was made, and while the non protein nitrogen was 46 and the rest of the blood chemistry correspondingly the same, and the centrifuged specimen showed the presence of no tubercle bacilli, we decided to try a retention catheter for drainage.



Fig. Hypertrophy of the right kidney, showing the enlarged size and the presence of a large, dark, lobulated mass, possibly a tumor or a large cyst, and surrounding tissue.

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TABLE V—WOMEN DYING OF ADVANCED PULMONARY TUBERCULOSIS—71 KIDNEYS

P h logy	N ber	Per cent age
G alized muf ry (b l t r al)		4
Th t r m l d b g f m		
rupt ed od f pyram d l t b r cl		
th t p d f b ped t p f d		
t p l f ty		
Lo l ed muf ey (b l t f)	4	6
Hyp rpl t t b r cl		4
T t f	6	8.8
M l ry bsc (p bly t b r cl)	5	7

TABLE VI—WOMEN DYING OF ADVANCED PULMONARY TUBERCULOSIS

P h logy	N ber	Per cent age
Bl d d		3
Ul t		
Ut ru t b n	64	
G alized m l ry (prim ry in k l y)		
Loc l u d f p e t m		5

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th wh l g nat ry y t m (4) Th k d y f t
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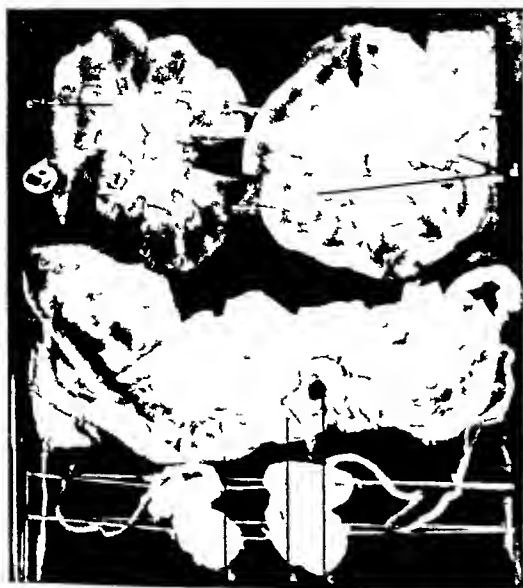


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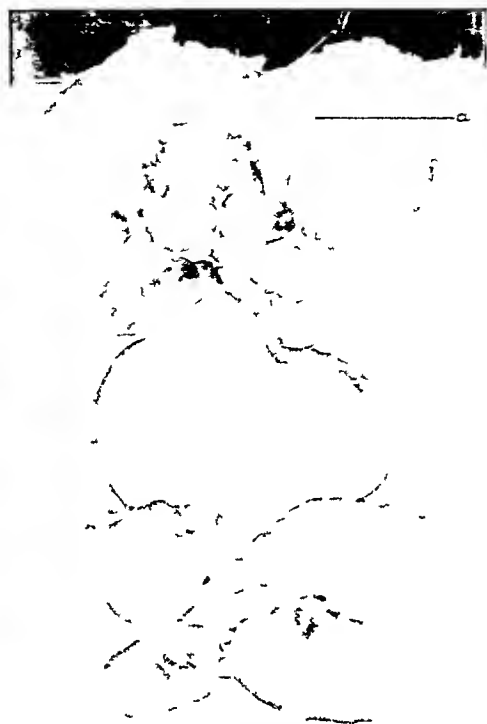


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b y p l p t i h g h t h t m b y c y t s c o p m
t S t w t t t h t h a t r y d
g t l y r p d t f i d t h t t h p t t h y l t t
g u l e m

Th p t m d t f l e c r y d p t h
t m f t h w l g h n t w a r d e s l f m
t h p e t g n f d w f e s l f m
e p d y m a Th n w t t b r e l b l l b e f
d h h w n i n t h p t l l p e c m
h t h p p f l p r i m r y t b l l f t h
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t r a t h l t h m t p h l y t h t b c u l
l e s m y h b e s t l w h

DEDUCTIONS

The principal features of this study may be stated rather briefly. Most important is the fact that there seems to be a sharp differentiation between the genito-urinary involvement as a terminal process in the pulmonary tuberculosis and the process that manifests itself primarily in the genito-urinary tract. The former is essentially unilateral and bilateral and rarely requires surgical intervention. The hyperplastic types (those associated with a generalized nodular tuberculosis) may be unilateral but are not likely to require surgical treatment because such a type of tuberculosis is rather progressive at any stage and not easily amenable to any kind of treatment. The other group is the one of most importance from a surgical standpoint. Such lesions must be grouped into surgical and medical but this classification is a difficult clinical problem. No doubt many cases are distinctly surgical but the surgery must be done at a point to meet the method adapted to the type of disease. On these factors depend the outcome of treatment.

It is a little to remove a kidney, especially if badly infected prostate to affect the prostate side or to remove an epididymis, a diseased infected seminal vesicle. Not infrequently there occurs a tuberculous rarely of the prostate. Either of these processes should be diagnosed early and removed by an operation and the operation should be sufficient. It is to eliminate all of the local infection if it is done at all.

The operation of the epilym shall be defined by the spread reaches the es des other

wise vasectomy and perhaps prostatectomy should be done. To leave an infected prostate means that the spread will continue to the testis and perhaps to the kidney eventually.

There are also times when the kidney is removed when it has been decided that a pyelonephritis is negative, to find that there is in the supposedly normal kidney an enclosed caseous tubercle that ruptures later. A definitely established advanced unilateral tuberculous kidney must be removed but it should not be done until a painstaking study of the other kidney has been made.

We believe that tuberculosis of the prostate is more common than the literature would lead us to believe.

CONCLUSIONS

In a report on the autopsy findings in 174 patients dying of pulmonary tuberculosis the genitourinary findings reveal

1 The kidney is affected in 10.3 per cent of the male and 8.8 per cent of the female patient and the tuberculous is usually bilateral and inoperable in most of the cases.

2 In some instances only one kidney is involved in the presence of a generalized disseminated large nodular tuberculosis in perable

3. No operable kidney lesions were found in this series of patients dying of primary tuberculosis.

4. Operable tuberculosis of the kidney is more likely to be found in patients having a trapezoidal lesion of the lung than in patients with minor foci in the lungs.

5. Primary genito-urinary tract tuberculous involvement of the epididymis in 80 per cent of cases. This type is operable if operation done early. The extent of the operation depends on the amount of spread of the disease to the other part of the genito-urinary tract.

6 Primary tuberculous of the prostate occurred in 4.2 per cent of these patients. This disease is perhaps more common than the epotals indicate.

A clinical report stated what appeared to be a primary prostatic tuberculous (efferable to the genitourinary tract). A clinical report is also stated to show the skeletal lesion resembling a tuberculous kidney with a negative pyrotoxic kidney.

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RIGHT PARADUODENAL HERNIA¹

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PARADUODENAL hernia: the term given to hernia situated in the duodenal jejunal flexure which come under the classification of intra abdominal or retroperitoneal hernias. They are rare and have never been diagnosed clinically. They are characterized by the protrusion of abdominal contents through a congenital or anomalous opening wholly within the abdomen.

Paraduodenal hernias are of two types: right and left. Thirty-four of the right and twenty of the left have been recorded in the literature. Of the thirty-four cases of right paraduodenal hernia, seven came to operation, the remaining twenty-seven being found at autopsy. Of the twenty operated upon, there were six recoveries and eleven deaths. My case makes the thirty-fifth reported, the eighteenth that came to operation and the seventh recovery.

The origin of all these intra abdominal or retroperitoneal hernias is considered to be at various points in the abdominal cavity where rudimentary fossae are found. Moynihan describes six of these fossae about the duodenal jejunal flexure in which internal hernia may be found. The most important are the superior and inferior paraduodenal fold and the fossae of Waldeyer and of Landert.

There are numerous theories concerning the formation of folds and fossae about the duodenum. Waldeyer considered the elevation of the peritoneum by blood vessels to be an important factor. Toldt explained the fossae as physiologic adhesions. Other theories are of embryonic origin, as late descent of the cæcum, formation of pockets during intestinal rotation, formation of fusion folds in fetal life, and failure of the root of the mesentery to unite with the posterior abdominal wall. The latter theory was advanced by Moynihan and is accepted by most modern writers.

The fossa of Landert (Fig. 3) is the space beneath the fold resulting from the union of the transverse peritoneal fold forming the superior and inferior paraduodenal fossae. This fold contains about five millimeters of free edge, the inferior mesenteric vein and a branch of the left colic artery. The orifice of the fossa looks to the right and herniation into it progresses upward, upward to the left and retroperitoneally. This represents a left paraduodenal hernia and is by far the most common type.

Moynihan describes the fossa of Waldeyer as

lying in the first part of the mesojejenum bounded in front by the superior mesenteric artery and behind by the lumbar vertebrae. The fossa so formed lies to the right of the body and its orifice opens toward the left. The peritoneum of the left leaf of the mesentery lines the fossa; that of the right covers the blind end and is then continued directly into the posterior parietal peritoneum. A forcible enlargement of the fossa would then result in a tearing up of the layer of peritoneum lining the posterior abdominal wall. The most common fold and fossae are the superior and inferior paraduodenals. These folds are composed of thin nonvascular peritoneal membranes passing laterally from the blind to the posterior abdominal wall (Fig. 3).

In considering the origin of the right paraduodenal hernia, Nagel of the Mayo Clinic states: "It has not been definitely established since it has not been observed in the early and progressive stages but that nearly all observers agree that the condition represents a true herniation of the intestines into the orifice of the other of the fossae about the duodenojejunal flexure that a knowledge of the embryology and anatomy of these fossae is essential to the proper understanding of these types of hernia. That the entire subject has been needlessly complicated and confused by different names attached by various investigators to identical structures, this nomenclature being no doubt due to the wide normal variations in size, shape and manner of details of the peritoneal fold in this region."

Nagel, Mass, and McIndoe consider a lower inferior paraduodenal fossa to be the site of origin of some right paraduodenal hernias but do not deny the possibility of right paraduodenal hernia occurring into the fossa of Waldeyer. Moynihan considers it altogether responsible for the development of this type of hernia.

Moynihan lays down the following conditions as invariably present in right paraduodenal hernia:

1. The sac occupies at first at least the right half of the abdominal cavity, lying behind the ascending and transverse mesocolon.
2. The orifice is situated behind and to the left of the sac on the lumbar vertebra.
3. In the anterior margin of the sac there lies the superior mesenteric artery or a continuation of it—the ileocolic artery.

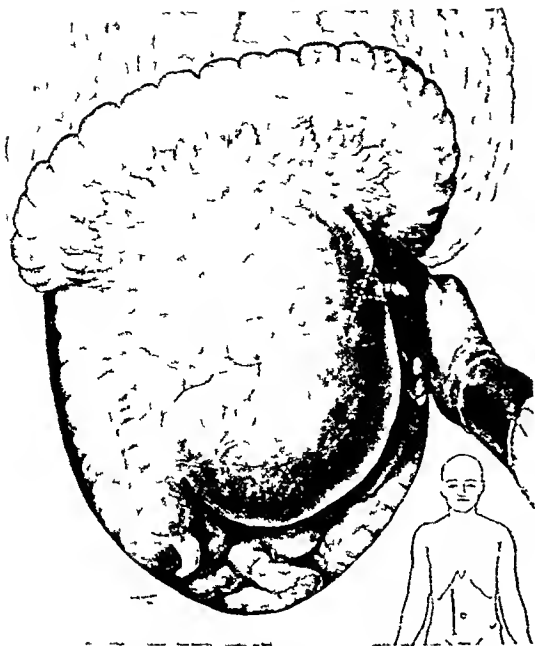


Fig 1 Right paraduodenal hernia, resulting in a large mass occupying the greater part of the abdominal cavity. The mass, consisting of most of the small intestines and mesentery, is covered by posterior parietal peritoneum which has been stripped up and lifted forward. The forefinger of the right hand is seen entering the hernial opening, rather high up and posteriorly on the left aspect of the mass. The finger was easily visible through the transparent peritoneum. The drawing is semidiagrammatic in that the intestines were not visible, as in the drawing, through the peritoneum covering them. To the lower right hand corner is seen the relative size and position of the abdominal incision.

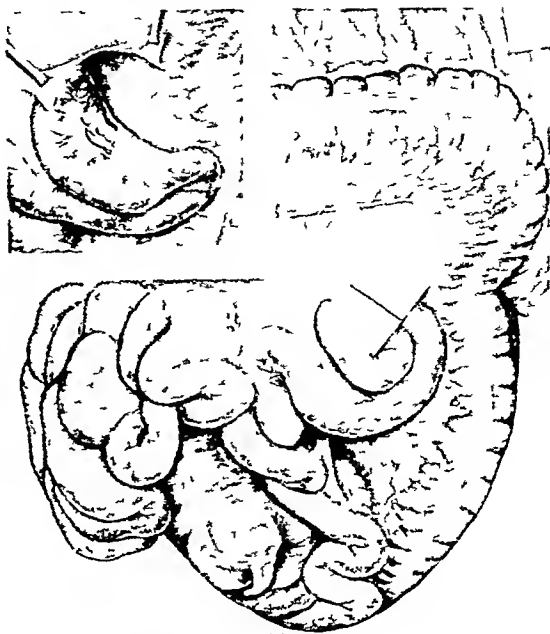


Fig 2 The hernia reduced up to the jejunum, a loop of which still remains under the fascia like membrane which extended from the left surface of the first 3 or 4 inches of jejunum to the left side of the base of the transverse mesocolon. This membrane pulled the jejunum to the left and fixed it to the posterior parietal wall. The lower edge of the membrane was very firm and formed a rigid neck of the hernial aperture. In the upper left corner is shown the conditions resulting from the division of the adventitious membrane. The first few inches of the jejunum actually flapped to the right, and the left aspect of the mesentery of it, and the portion of the posterior abdominal wall with which it was in contact, were devoid of peritoneum, this latter combination of factors resulting in a congenital aperture which accounted for the origin of the hernia.

Broesike emphasized a fusion of the first part of the jejunum to the posterior abdominal wall which he found in two of his subjects and which he believed to be essential for this type of hernia. This condition has also been observed by others. Moynihan makes this the basis for a division of right paraduodenal hernias into two types, calling those in which the jejunum is adherent "hernia mesenterico-parietalis parajejunalis," and those in which it is free, "hernia mesenterico-parietalis paraduodenalis."

Edmund Andrews calls the term "duodenal hernia" a misnomer and considers the condition a congenital anomaly due to imprisonment of the small intestine beneath the mesentery and the developing colon, and states "the view that these small peritoneal pouches of which there are hundreds scattered throughout the abdomen are the origin of these hernias, is absurd and grotesque." He asks "How can anyone conceive of a force

which would, once begun, practically always continue to act until all the guts had been segregated into a sac, even when the remainder of the belly is empty?" In support of his belief, are the following statements:

- 1 Differential pressure is utterly lacking within the abdomen so that any *vis a tergo* to account for the formation or growth of such hernias is totally absent.

- 2 There are hundreds of similar folds and fossæ in the peritoneum, many of which are of greater size and are practically never the site of such hernia.

- 3 In all but a very small minority of the cases reported, the degree of herniation has been total or subtotal.

- 4 A case of total hernia in a newborn infant was reported (Left duodenal hernia of Vogt).

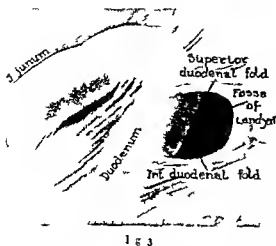


Fig 3

5 The herniated viscera are never anything but small bowel. The presence of omentum has never been reported.

6 In many cases there has been an almost universal grooving together of content of the sac.

So far not a single case of right paraduodenal hernia has been diagnosed before operation or necropsy. It may be observed at any age; the youngest patient being that of Paton, age 3 months, the oldest reported by Rose, a woman of 68 years. There were 21 males and 3 females in 20 cases; the sex is not noted.

The great majority are operated upon for symptoms of acute obstruction which may follow several similar attacks or occur suddenly in a previously healthy patient. In the more chronic type the symptoms have been likened to those of chronic duodenal ulcer, but they resemble rather those of chronic duodenal ileus. In others the case may be more or less severe persistent pain with a little or nothing as in chronic intussusception. Lastly, the condition may remain symptomless and be found at necropsy.

The most important physical signs are:

1 Vomiting, which may be strictly absent even when obstruction is complete. If not due to the vomiting, it consists mainly of bile. There can be no regurgitation of small intestinal contents.

2 Visible peristalsis—a sign of chronic obstruction occurring in the bowel above the site of obstruction.

3 Palpable swelling. This is the most important diagnostic sign when present. It is described by Moynihan as a palpable, firm, resident mass which lies at first to the right and lower part of the abdomen but spreads finally over almost the whole abdominal cavity. On

auscultation distinct gurgling sounds may be heard anywhere over the tumor.

4 Result of X-ray examination. (1) When there is no obstruction, the colon may be shown occupying the left half of the abdomen with the coils of small intestine to the right. (2) When there is chronic obstruction of the afferent loop, the X-ray picture will be similar to that found in chronic duodenal ileus, namely, dilatation of the stomach and duodenum with delayed emptying.

5 Tachycardia and collapse. These vary according to the intensity of the acute obstruction and the amount of small intestine extruded.

The treatment of this condition should be surgical operation, undertaken as early as a stage as possible. The mortality is undoubtedly influenced by the same factors that govern intestinal obstruction due to other causes, but in the same segment of the alimentary canal. The presence of important vessels in the neck of the sac (in the case of left paraduodenal hernia—the inferior mesenteric vein and in the case of right paraduodenal hernia—the superior mesenteric artery) should be constantly borne in mind. Whenever possible, the sac should be ablated or its mouth closed. The postoperative course is similar to that following intestinal obstruction due to other causes.

Following is the report of the author's case of an incarcerated right paraduodenal hernia causing an acute intestinal obstruction.

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malities The abdomen was moderately distended throughout. No masses of peristaltic waves were visible. There was generalized tenderness and rigidity throughout which was most marked in the central part of the abdomen. A rather indefinite mass seemed to occupy almost the entire central part of the abdomen, but on account of the rigidity and distention, one could not be positive about this. Auscultation revealed nothing abnormal, such as gurgling, etc.

Temperature at the time of admission and examination was 101.5 degrees F, pulse, 90, respirations, 18. The white blood cells numbered 24,000, polymorphonuclears, 90 per cent. The urine was normal.

A diagnosis of acute intestinal obstruction was made, either the result of intussusception or volvulus, the diagnosis being based on the presence of a mass in the abdomen, together with the passage of blood during the afternoon.

Operation The abdomen was opened through a right rectus incision just below the level of the umbilicus. The appendix was found in its normal location but it presented a markedly ischemic, putty-like appearance. The cecum was also contracted and ischemic in appearance. Exploration revealed a large rounded mass occupying the entire center of the abdominal cavity, whereupon the incision was enlarged upward and downward, until it was about 7 inches in length. The incision was spread wide open with retractors, thus disclosing the mass (Fig. 1) which was found to be cystic and very tense throughout and covered with fat laden peritoneum. Anteriorly, the mass was practically in contact with the parietal peritoneum over a large area. On the right it extended to the ascending colon, above it reached to the transverse mesocolon, on the left it "bulged" well over toward the descending colon, while below it extended almost to the promontory of the sacrum. No coils of small intestine were seen.

The entire large colon was ischemic and contracted. The ascending colon was pulled to the left and the right kidney was palpated and its outline visualized through the peritoneum to the right of the ascending colon. The nature of the mass and its origin could not be determined for a considerable interval, regardless as to how I approached it, as it was attached to the posterior abdominal parietes over a large area and was quite fixed in position. I felt that I was dealing with a retroperitoneal condition—a pancreatic cyst or a mesenteric cyst being the uppermost diagnoses in my mind. Finally, after many unsuccessful efforts to determine the real nature of the condition and when I was about to open the presenting surface of the mass, my right forefinger entered an opening, which seemed to be 1½ inches or so in diameter, high up on the left aspect of the mass and to the left of, and about on the level with, the second lumbar vertebra (Fig. 1). The outline of my finger was visible through the peritoneum covering the mass. I then realized that I was dealing with a paraduodenal hernia and that the mass was made up of practically all of the small intestines and their mesentery.

The nearest coil of small intestine at the lower half of the hernial opening was then grasped and by pulling down and to the left, the small intestines with their mesentery were easily removed from the sac and restored to their normal position in the abdominal cavity. There were no adhesions between the coils of intestines, and they were markedly contracted throughout. As they were pulled down and out from the sac, there was a marked difference noted in their color, some portions being very dark purplish and mottled, while others were markedly red and injected. When the proximal part of the jejunum was reached, considerable pull was necessary to liberate it, but when liberation was accomplished, it was found that the intestines had been pulled from under a firm fibrous membrane, which extended from the left surface of the jejunum over

a length of about 2½ inches, to the left side of the base of the transverse mesocolon (Fig. 2). The lower edge of this membrane was very firm and dense and formed the neck of the hernial sac. This band of tissue was broken up between the thumb and forefinger, with great caution, since I realized that either the superior mesenteric artery or some of its branches, or the inferior mesenteric vein, might be intimately involved in the neck of the sac. It was then seen that the band of tissue had been binding down about the first 3 or 4 inches of jejunum with its mesentery to the posterior abdominal wall and when the band was divided, the jejunum actually flapped to the right as though it had been under considerable tension. The left surface of this portion of the jejunal mesentery was found to be devoid of peritoneum, the jejunal vessels standing out prominently in the mesenteric fat (Fig. 2). Also, the posterior abdominal wall to which the jejunum and its mesentery had been bound down, had no peritoneal covering. In this region there was a small amount of milky fluid which had the appearance of chyle.

The conditions, as now revealed, made it evident that this anomalous opening or aperture in the peritoneal investment of this part of the abdominal cavity allowed the small intestine to progress to the right, retroperitoneally, and under the superior mesenteric artery, strapping up the peritoneum of the posterior abdominal wall as it progressed, once a knuckle of gut had started to invaginate under the hernial ring described, until practically all of the small intestines and mesentery were retroperitoneal and formed the mass. I believed that I had rid the patient of the possibility of a recurrence of the hernia, for I had destroyed the anomalous membrane and hernial ring, so no attempt was made to do anything further, in fact, it did not seem possible to do anything further, and the abdomen was closed in layers without drainage.

The patient made an uneventful recovery, the pulse and temperature were normal within 24 hours after operation. There was no postoperative vomiting, distention, or any other untoward condition. The bowels functioned normally throughout the remaining stay in the hospital. The patient was discharged as cured on Sunday, May 2, 1926, 13 days after operation. The patient has been seen several times a year for the past 4½ years, and there is no evidence of any return of the hernia, nor are there any intestinal symptoms which would make one suspicious of same.

CONCLUSIONS

The case herein reported presents the following unique and interesting features, considering all the divergent views and contentions that exist concerning these paraduodenal hernias:

1. It represents a right paraduodenal hernia the origin of which was very obvious in that there was a congenital anomaly of the normal peritoneal investment of the abdominal cavity in the region of the jejunum, this anomaly consisted of (1) The left surface of the mesentery of the first 3½ or 4 inches of jejunum and the posterior abdominal wall with which it was in contact, devoid of peritoneum, with a resultant opening or aperture in the normal peritoneal investment which could and did allow the escape to retroperitoneal position of the intestines and their mesentery. (2) A hernial ring which was formed by the lower edge of the firm fibrous band which extended from the

left aspect of the jejunum to the left base of the transverse mesocolon and once a knuckle of gut had started to invaginate under this ring peristalsis caused the whole intestine ultimately to assume the retroperitoneal position (In contrast to these findings Nagel states that the origin is not definitely established as such hernias have not been observed in the early progressive stages)

2 There was present what Broeske emphasizes in the origin of these hernias and what he found in two of his subjects namely fusion of the first part of the jejunum to the posterior abdominal wall and which Moynihan classifies as hernia mesenterico-parietalis parajejunalis

3 Whereas Nagel and nearly all observers agree that the condition represents a true herniation of the intestines this was not so in the author's case as almost the entire small intestine and mesentery had escaped into a retroperitoneal position through the congenital defect in the peritoneal lining of the abdominal cavity there being no sac of peritoneum forced ahead of the intestines. The posterior parietal peritoneum in the right half of the abdomen formed a sac for the intestines as a result of having been stripped from the posterior abdominal wall and lifted forward

4 The lifting up of the posterior parietal peritoneum resulted in the ascending colon being pulled to the left to the extent that the right kidney was palpable and its outline visible through the peritoneum to the right of it

5 Whereas Edmund Andre's contend that the term duodenal hernia is a misnomer in that differential pressure is utterly lacking within the abdomen so that there is no account for the formation and growth of such hernias is totally absent in the cases which conditions are unnecessary as there is no sac forced ahead of the intestines. Also there were no adhesions growing together of the contents of a hernia which he claims were found in many of the reported cases

6 In one respect it differed from the conditions as laid down by Moynihan which are invariably present in right paraduodenal hernia in that the superior mesenteric artery was not seen or felt in the anterior margin of the sac before the hernia was reduced. This condition could not be present in this case as the first part of the jejunum was pulled over to the left and fused to the posterior abdominal wall and in the formation of a hernia the intestines had to pass under this portion of the jejunum before passing under the superior mesenteric artery and its branches. However although not seen the superior mesenteric artery must have

occupied a position in the anterior part of the neck of the hernia as the intestines had to pass posteriorly to it to assume the retroperitoneal position which they finally reached

7 The other two conditions laid down by Moynihan namely (1) the hernial sac occupying principally the right half of the abdomen and lying behind the ascending colon and (2) the orifice situated behind and to the left of the sac and on lumbar vertebra were present in this case

8 The caecum appendix and ascending colon were markedly contracted ischaemic and pink like in consistency and color which must be explained by their blood supply being interfered with due to the torsion of and traction on the root of the superior mesenteric artery and its branches by the rotation posteriorly around it and to the right of practically the entire length of small intestine and mesentery

The author wishes to express his appreciation to the following for their assistance in the preparation of this manuscript

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FEBRUARY, 1932

THE SELECTION OF GASTRIC ULCERS FOR SURGERY

IN our endeavor to improve the statistics of operations for carcinoma of the stomach, surgical attention has very naturally been directed toward gastric ulcer as a causative or at least a suspiciously associated lesion. There is a very natural and distinct tendency to assume the position that duodenal ulcers with their lack of danger of malignant degeneration may be safely submitted to a trial of non-operative measures, but that all gastric ulcers are at once surgical. This position is assumed because of the danger of overlooking a malignant lesion in an ulcer, because of the incorrect assumption that they are less readily healable than are duodenal ulcers, and because of the assumption that they are forerunners of malignancy.

Dr. Sara M. Jordan has instituted a diagnostic policy which has proved of great satisfaction in this clinic, to the surgeons and gastro-enterologists alike, in helping to distinguish those borderline gastric lesions immediately requiring surgery from those which

may be treated by non-operative measures without fear of the development of malignancy.

For a period of one to two weeks the patient is kept under observation in the hospital. During this time he is given most accurate and painstaking Sippy neutralization treatment. The procedure is carried out only in those patients in whom the question arises as to whether or not the lesion is a chronic gastric ulcer, an early carcinoma, or a gastric ulcer with associated malignancy. As long as the frequent fluoroscopic examinations show that the defect in the gastric outline progressively improves, and as long as the symptoms improve and occult blood disappears from the stools, no operative procedure is advised. If the defect in the X-ray picture completely and persistently disappears with the result that the part at which the lesion was present becomes soft and flexible, and the peristaltic waves therefore readily pass through this area—and this can be accomplished in a great many of the cases—surgery is not advised.

If the defect as demonstrated with the X-ray cannot be made to improve, if it cannot be made to disappear completely, even if but a small dimple persists after almost complete disappearance, surgery is advised. This is especially true if symptoms persist and occult blood continues to be present, and even when these two latter criteria are not present and the defect has only incompletely disappeared, it is advisable to operate, since the lesion is then obviously either frankly malignant or a non-healable ulcer.

The plan thus briefly outlined has been employed in this clinic in ninety-six cases of

gastric ulcer suspected of malignancy and has been found to be of real value. For a plan which removes all gastric ulcers in order to eliminate those in which carcinoma may occur (certainly not over ten per cent) the method substitutes a scheme whereby one may segregate borderline gastric lesions into those which are at once justifiably surgical and those which are justifiably and with reasonable safety non-operative. The procedure eliminates exploration for the borderline chronic gastric ulcer suspected of malignancy which does not possess obvious and visual evidences of malignancy at this state. Exploration results only in resection. Once the abdomen is open who has the courage to close it and say that there is no malignancy in a chronic calloused gastric ulcer even when there are no obvious metastatic glands or definite peritoneal plaques?

This plan has rendered us much mental comfort. Our conscience has never been quite clear in doing such a serious operation as partial gastrectomy for all gastric ulcers in order to be rid of the dangerous few but when after this plan of selection one undertakes partial gastrectomy with its certain risks one's conscience may be clear for he feels that his advice is justifiable. FRANK H. LAHEY

SURGICAL CONSCIENCE

SURGICAL conscience is the measure of a complete service to the patient and is the result of humanizing all the aid available through scientific procedure. It contributes intuition and courage in forming judgment for it should be remembered that a duty still remains after the judicious application of every diagnostic and therapeutic measure offered by modern scientific surgery. Complete accurate records may be a mature surgeon at times cannot make a correct diagnosis

from a review of the record unless he also makes a clinical examination of the patient. Years ago surgical judgment lacked sadly the basic principles afforded by complete pathological findings. Today however it might be said that these two factors have become reversed in importance because of the overemphasis of the value of laboratory findings. It requires a surgical conscience to be able to make the diagnosis of a surgical condition without waiting for a prolonged clinical study which might make an accurate pathological diagnosis possible but would seriously interfere with the patient's chances for recovery.

The term surgical condition seems to be a more rational nomenclature than the word exploratory operation. For instance in the presence of acute abdominal conditions we have found that in 384 crises in which operation was done within the first 24 hours with no mortality the errors in pathological diagnosis were ten times those which were made when operation was delayed 48 hours and the mortality was considerable even though the errors in making the diagnosis of surgical condition were practically nil. The master French surgeon Faure in a recent address in Science and Conscience in Surgery says: But we know also that it is a serious thing to do nothing and that a too comfortable conservatism is very often more dangerous than the thing which the weak and powerless call boldness. When the surgeon condones a negative mistake his conscience should be revived for surgical courage is not incompatible with surgical conscience which is so often called upon to make a choice between an unavoidable evil. At times it is necessary that the surgeon ask himself what he would wish done were he in the patient's place. Giving patients what they want in a doubtful case under the guise of correct medical procedure violates conscience.

In this age of economic stress, the surgical conscience is being put to the test of reckoning with phases of surgical activities which heretofore have been ignored. Today physicians in general must revise certain economic policies, for instance, they must endeavor to reduce overhead expenses and to attain a more equitable adjustment of charges while at the same time they must maintain scientific efficiency—all of which works toward an indirect benefit to the patient. With better business methods the surgeon with a good conscience will maintain an equitable income and a satisfied clientele if he reduces the number of those undeserving delinquents who are not entitled to charity, for he will thus save the necessity of overcharging the well to do—a procedure which has invited

unpleasant criticism of the profession as a whole. The percentage of the wealthy in the clientele of the average surgeon is becoming smaller and smaller. Economic policies in every line require readjustment. Conscience should lend a sympathetic ear to the great self-respecting middle class, for now as never before do they dread the expense of illness more than the ordeal of surgery and will even hazard health and life rather than incur a debt that cannot be paid. A popular author in his "Prayer of the Physician" says "Give me money, not so little that I cannot have the leisure I need to qualify into my service, not so much that I shall grow fat in head and leaden in heart and sell my sense of ministry for the flesh pots of indulgence."

R. M. HARBIN

MASTER SURGEONS OF AMERICA

WILLIAM HENRY CARMALT

On July 1, 1929 William H. Carmalt died a few weeks short of the age of 94 years. He was born of Quaker parentage in Friendsville, Pennsylvania on August 3, 1836, and his lifetime spanned the introduction of anesthesia, the orientation of surgery around pathology, the discovery of antiseptics, the development of asepsis, the growth of the entire field of modern surgery, and the establishment of medical teaching under university auspices.

Brought up on a farm he pursued his elementary education at boarding schools and did not fix upon medicine as his profession until he was 21 years of age. He then studied for 2 years with the Doctors Wyman at Cambridge, transferring at the end to the College of Physicians and Surgeons in New York City from which he graduated with the class of 1861. It was at this time that he came under the inspiration and guidance of Dr. John C. Dalton, the eminent professor of physiology there, an association that undoubtedly influenced greatly his subsequent career. This period of training was completed by an internship at St. Luke's Hospital, following which he engaged in general practice in New York City until 1869, serving for a time with the Union forces in the Civil War.

His bent was very definitely toward ophthalmology, and during the latter portion of this period he was surgeon to the New York Eye Dispensary and ophthalmic surgeon to the Charity Hospital on Blackwell's Island. In 1864 he became a charter member of both the New York and the American Ophthalmological Societies. That this early specialization did not narrow his field of vision is shown by his subsequent career. In fact at the same period he was acting as a Commissioner of the New York State Agricultural Society and studying infectious abortion in cows, concerning which he drew up an authoritative report.

Not content with these auspicious beginnings and searching for a more thorough preparation for his undertaking of medicine, he gave over his practice in 1870 and went to Germany, where he studied for some 4 years under Stricker and Waldeyer, going with the latter to Strasbourg at close of the Franco-Prussian War. He acquired a thorough understanding of pathology and a knowledge of the Germanic medical literature which served as a background for his teaching and practice.

In 1876 he opened an office in New Haven, again as an ophthalmologist, and 3 years later was made professor of ophthalmology and otology in the Yale Medical School. In 1881 the chair of surgery having become vacant, he was transferred from the special into the larger field which he was to adorn for over 25 years. Like Sinds, his advancing years found him constantly broadening his activities rather than undergoing the customary shrinkage of interests.



WILLIAM H. CARMALT
1836-1929

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Shortly Dr Carmalt began to publish case reports which today are of value as indicating how closely he trod upon the heels of every advance in his field. Operations under the carbolic spray, asepsis, intestinal anastomosis, appendicitis, the treatment of peritonitis, the use of the roentgen-ray, early interference in gall-bladder disease, one can follow the evolution of surgery as it is portrayed in these. More formal contributions were not lacking however, the most characteristic of these being upon controversial subjects where the public and professional good required that some one of competence speak forth unreservedly. The case then was thoroughly prepared, the evidence assembled, the deductions clearly drawn, and the conclusions so stated that there could be no misunderstanding.

To his teaching he devoted much labor, not only in presenting his own experience but in assembling the literature pertinent to the question in hand. But of greater influence than his didactic presentation was the force of his personality as displayed in the handling of his patients. Honesty of thought, conscientious care, and intolerance of anything that smacked of cheap sentimentality or slipshodness held his students to a rigorous standard. Important as was this influence on the men coming in contact with him, much more so for his profession was his clear thinking and vision as regards medical education. From the first he foresaw and attempted to expedite the conjunction of the medical school and hospital as an educational enterprise, and although in his own consulship he was not to enjoy at first hand the consummation of his desires, he continued to support to the end of his activities the progressive plans of those coming after him.

The interest of Dr Carmalt in his patients, in the students, and in the medical school by no means exhausted his sense of responsibility. The successive calls to positions of importance within the medical profession, the presidencies of the local city, county, and state medical societies, the last of which he was counselor for many years, the presidency of the American Surgical Association, the positions of responsibility in the Congress of American Physicians and Surgeons, ending in over 20 years of service as chairman of the executive committee, these with many more minor positions were regarded by him as not purely honorary but as carrying with them obligations which he met most conscientiously.

By these many contacts, he became known as a rugged, fearless character with standards of professional conduct not alone for others but for himself as well. Usually gruff but even brutal where occasion demanded it, he neither tolerated "bunk" nor compromised in matters of ethics, yet achieved not only the respect of his profession but the affection of those intimate with him. He exemplified in himself the best qualities of the surgeon who knows the obligations of his profession in the broadest sense and fulfills them.

"Integer vitae sclerisque purus"

SAMUEL C HARVEY

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

ARATHER complete monograph has been written by Da adoff on the pathologic symptomatology of agnathism. The book is published by the Tallent Publishing Company, 100 West 10th Street, New York. The author is Dr. J. C. Da adoff, M.D., of the University of California, San Francisco. The book is a valuable contribution to the literature of the subject and is highly recommended.

The author deals with the symptomatology of agnathism in a clear and concise manner. He discusses the various forms of agnathism and their clinical manifestations. The book is well illustrated with numerous photographs and diagrams. It is a valuable reference work for the surgeon and the pathologist.

The author draws from all the available literature in the field. He has made a thorough study of the subject and has presented the results of his research in a clear and concise manner. The book is a valuable contribution to the literature of the subject and is highly recommended.

HAL H.

The second edition of the book by C. C. Da adoff, M.D., is a valuable contribution to the literature of the subject. It is a clear and concise presentation of the results of his research. The book is well illustrated with numerous photographs and diagrams. It is a valuable reference work for the surgeon and the pathologist.

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The chapters are well written and deal with the various forms of agnathism. The author is Dr. J. C. Da adoff, M.D., of the University of California, San Francisco. The book is a valuable contribution to the literature of the subject and is highly recommended.

The book by H. H. L. is a valuable contribution to the literature of the subject. It is a clear and concise presentation of the results of his research. The book is well illustrated with numerous photographs and diagrams. It is a valuable reference work for the surgeon and the pathologist.

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Arthur W. Burgess

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MURPHY, AND SOME PRINCIPLES OF URINARY SURGERY¹

PROFESSOR ARTHUR H. BURGESS, MANCHESTER, ENGLAND

WE are met tonight to commemorate a great man and a great surgeon, one who was recognized throughout the civilized world as the greatest American surgeon of his day, and one whom future generations will undoubtedly place among the greatest surgeons of all time. It seems only fitting, therefore, that at the commencement of each annual clinical congress of the American College of Surgeons, in the foundation of which he took so keen an interest and played so active a part, we should recall in respectful and appreciative remembrance—John Benjamin Murphy.

It was my good fortune to meet Murphy on three occasions, the last immediately before the outbreak of the Great War, when this congress met, for the first time outside America, in London, under his presidency. Well do I recall his commanding presence, his handsome appearance, his tall and erect bearing. Any slight surprise, on first hearing him speak, that Nature had not endowed him also with a proportionately powerful voice became rapidly dissipated in the beauty, the grandeur, and the consistence of his argument, and the obvious sincerity, enthusiasm, and earnestness of the speaker. Murphy undoubtedly possessed in a superlative degree the power of presenting his facts and his deductions therefrom in so orderly, concise, and forceful a manner as to convey the profoundest conviction. None who heard him could for a moment

doubt but that he himself was firmly convinced of the truth of all his statements, and that such belief was not born merely of intuition, but was founded upon prolonged observation of his facts and their careful testing by direct experiment. Himself fired with a restless energy, an indomitable enthusiasm, and a resistless sense of logic, he so influenced the members of his audience by his personal magnetism as to sweep them along with him to the inevitable and irresistible conclusion of his argument.

Although as a clinical teacher, Murphy was admittedly the most sought after of his time, the number of those privileged to have heard his spoken word is steadily diminishing and must of necessity dwindle to zero in the course of another generation. It is, therefore, by his published writings that posterity will judge him, nor need its verdict be feared. The volumes of his *Surgical Clinics*, published bimonthly from 1912 until his death, reveal his innermost thoughts upon the most varied topics of surgical interest, and many truths are there presented in the form of aphorisms so peculiarly appropriate as to command remembrance. Besides articles in textbooks and yearbooks of general surgery, Murphy published 66 papers in the medical and surgical journals, all of them substantial additions to surgical knowledge, and many of them of epoch making importance, practically everything he originated has become standard

¹The John B. Murphy Oration in Surgery presented before the Clinical Congress of the American College of Surgeons, New York, October 12-16, 1931.

practice today. In this era of increasing specialism it seems almost incredible that within such recent times any single individual could have written with such intense originality and authority upon so many and such diverse branches of the surgical art. As W. J. Mayo so aptly phrases it of Murphy: "We must remember the number of targets at which he shot and that he always rang the bell." The tendency of the present age is adverse to the development of men of Murphy's type and it may be confidently asserted that he was the last of that great generation of general surgeons whose genius was sufficient to enable them to grapple successfully with the intricate problems that arise in the entire field of surgical practice.

Murphy's earlier writings were concerned mainly with abdominal surgery and it was undoubtedly in connection with his button for intestinal anastomosis that his name first became prominently known outside America. I doubt whether any other surgical instrument has ever brought to its inventor such immediate and world wide fame as did his anastomosis button bring to Murphy. The surgical world of that date was just ripe to receive some such appliance. When anastomoses between the hollow abdominal viscera were first attempted union was effected by a very large number of interrupted sutures; much time and energy were expended in their insertion and leakage between them not infrequently occurred. Nicholas Senn, by the introduction of his bone plates, had eased the situation to some extent but their correct application was rather difficult and sutures were still required. Murphy endeavored to devise some means of holding the surface of the two viscera to be anastomosed in sufficiently firm contact to ensure speedy and permanent union to keep the opening between them large enough for their contents to pass freely and to leave a cicatrix that would not subsequently contract. After many experiments on dogs he introduced his button and provided surgeons with an easier, quicker and safer method of anastomosis than any hitherto available. This gave a great stimulus to the surgery of the stomach and intestines and although other mechanical devices were

brought forward from time to time the Murphy button easily held its own. Its supreme value however has been as an educational factor—it taught us the essential principles of union between peritoneal clad surfaces and proved that all that is really necessary is to maintain them for a few days in close and even contact. Though it is now the almost universal practice to dispense with any form of mechanical device in performing visceral anastomosis yet it can be truly said that the Murphy button has been the most valuable single educative step in the history of abdominal surgery and that without it the marvelous progress since obtained would not have been possible.

The closely allied conditions of appendicitis and peritonitis early attracted Murphy's attention and he was a pioneer in his advocacy of their treatment by early operation. In this connection it was that he uttered that most famous of the numerous aphorisms in which his teaching abounded—*Get in quickly get out quicker*—a dictum which if interpreted in the strict sense that Murphy intended correctly and tersely indicates the two most essential points in the operative treatment. In concluding his masterly paper on *Perforative Peritonitis* Murphy stated: "We believe that the results of the future can and will be uniformly good. This estimate involves the assumption that the medical profession will make early diagnosis, will insist upon early surgical intervention, will limit its surgical procedures to the least possible handling, and trauma consistent with closure of the opening and relief of pus tension will limit the duration of anesthesia and quantity of anesthetic will shorten the actual time of operation will insure the continued absence of pus tension will eliminate the pus already in the blood restore the blood pressure and will inhibit septic absorption by position." I cannot conceive that the essential feature in the treatment of peritonitis could ever be stated more concisely or more accurately and although these words were written almost a quarter of a century ago nothing of importance requires to be added to them today. They still represent the truth, the whole truth and

nothing but the truth, in the treatment of acute peritoneal infections—a truth, moreover, which amounts to an almost complete reversal of all that was previously considered orthodox. Of all Murphy's contributions to surgical progress, this recognition of the defensive and protective capabilities of the peritoneum and the principles by which these can be aided and not hampered in their beneficent efforts constitutes, in my opinion, his supreme achievement. Only those of us who, by length of experience, are able to contrast the results of surgery in peritonitis prior to Murphy's epochal work with those now being obtained can realize what an enormous number of lives he has already been the means of saving, and what an immeasurable load of human suffering he has already prevented.

Of Murphy's other contributions to abdominal surgery, mention must be made of the "Murphy-drop" method of introducing large quantities of saline solution by continuous rectal infusion—a method that has made his name a household word in every hospital—of his monumental production upon ileus, of his pioneer work in the treatment of gunshot wounds of the intestine, of his original procedures in the surgery of the stomach and gall bladder, and of his researches into tuberculous peritonitis. In other surgical fields, Murphy was the first to perform successfully end-to-end suture of an artery in the human being and one of the first to remove an embolus from a large artery, he was a pioneer in the treatment of pulmonary tuberculosis by the introduction of nitrogen gas into the pleural space, and his exhaustive contribution on neurological surgery¹ was certainly the most complete, careful, and concise summary of the subject that had been written up to that time. His later writings were concerned mainly with the surgery of the bones and joints, and his pioneer work in the transplantation of bone, in the prevention of ankylosis following arthritis, and in the restoration by arthroplasty, of movement in ankylosed joints, is admittedly of the most outstanding merit. Murphy's interest was not confined, however, to the purely scientific aspects of surgical

work, and many of his addresses concern both the medical profession and the lay public. He emphatically denounced all fads and all forms of quackery, whether within the profession or without, he strongly supported all measures to promote the public health, he stoutly defended experimental research in medicine, and he was a powerful advocate of the systematic instruction of the public in medical affairs by means of inspired articles in the lay press, and by popular addresses and cinema demonstrations during the sessions of medical congresses.

To a remarkable extent, Murphy possessed the ability to sift rapidly the essential from the non-essential and to establish broad basic principles, ever did he emphasize the practical application of the fundamental principles of surgery to the daily work of the surgeon. My predecessors in this oration have shown how he applied these principles in certain selected spheres of his surgical activities, but only scant reference has yet been made to that of the urinary system. I propose tonight, therefore, to consider some of the principles of urinary surgery, and Murphy's work in relation thereto.

RENAL FUNCTIONAL TESTS

One of the first principles of urinary surgery, and one which Murphy continually stressed throughout his teaching, is that the state of the renal function as a whole must be thoroughly appreciated before any capital operation is performed upon the kidney, or, indeed, upon any part of the urinary tract. It is essential to know beforehand not only that there is a second kidney actually present, but also that the functional capacity of that kidney is sufficiently good to carry on life, should its fellow require to be removed. In precystoscopic days it was often quite impossible to obtain this information, and disaster was not infrequent. My old chief and predecessor in the chair of surgery once confessed to me that during his 35 years of practice he had on three occasions removed a patient's only working kidney. Such errors, though at that time unavoidable, are quite inexcusable since the advent of the cystoscope and the many tests of renal function. These

¹ *Su. g., Gynec. & Ob. t.* 190 April

have enabled us to measure the functional capacity of the kidneys either conjointly or separately with an accuracy that is truly remarkable and which compares very favorably with that obtainable in any other system of the human body. Would that we could size up the functional activities of the liver for instance with the same precision that we can those of the kidney.

Of the many tests of renal function that have from time to time been proposed the surgeon is chiefly concerned with those which while trustworthy are yet readily practicable. These comprise on the one hand the biochemical tests of the blood for nitrogen retention and on the other hand the tests of the powers of the kidneys to eliminate either *endogenous* products e.g. urea chlorides or *exogenous* substances like indocarmine or phenolsulphonephthalein. Of the blood tests the estimation of the urea nitrogen is that most commonly employed from 15 to 40 milligrams per 100 cubic centimeters of blood being considered the limits of normality. The most frequently used of the *endogenous* kidney elimination tests is in England Maclean's urea concentration test and this with the modification suggested by Calvert in which by suitable administration of fluid the range of urea concentration from the most dilute to the most concentrated can be readily estimated constitutes probably one of the very best tests in present use. Of the *exogenous* elimination tests the indocarmine and the phenolsulphonephthalein tests are the two most favored. The latter is certainly the better quantitative test but the former has an exceedingly high qualitative value and is particularly useful in detecting differences in function between the two kidneys moreover it does not require catheterization of the ureters. After 30 years use of this test in every urological case under my care I have acquired great confidence in its findings. After the intravenous injection of 10 cubic centimeters of a 0.4 per cent solution of indocarmine the dye appears at the ureteral orifice within from 3 to 5 minutes in 95 per cent of normal kidneys the limits of normality being from 2 to 7 minutes. If delayed beyond

this or if the initial light blue shoots do not quickly deepen to the typical dark blue then disease of the corresponding kidney must be suspected. Valuable differential information is obtained by comparing the efflux from the two orifices as to the time of first appearance of the dye the depth of tint the frequency of the shoots and the force with which they are ejected. I regard the indocarmine as the most practical renal elimination test we possess for systematic ward use but reliance should never be placed on any single test—two or more ought to be applied in every case and in my wards the blood urea urea concentration and indocarmine tests are used routinely in all cases.

Though *urography* (including *pyelography* *ureterography* *cystography* *urethrography* and *vesiculography*) when performed by the older method of introducing opaque media directly into the urinary tract (*retrograde* or *ascending urography*) yields most valuable information of the anatomical shape size and position of its various component parts yet it gives no evidence of the renal function. In 1923 attempts were made to remedy this by introducing a shadow casting substance into the circulation so that on its excretion by the kidneys radiography would reveal the outlines of the renal pelvis and ureters. Thus in America Osborn Sutherland Rowntree and Scholl in Germany von Lichtenberg and Rosenstein and Vollmann used for this purpose intravenous injections of 10 per cent solution of sodium iodide. Rosen of Cologne later experimented with a compound of sodium iodide and urea (*pyelognost*) and obtained good pictures but found that toxic symptoms occasionally followed. In 1929 M. Swick in Berlin who worked with Lichwitz and later with von Lichtenberg used a drug which had been synthesized by Binz and Raeth for use against coccus infections of the biliary and urinary tracts—selectan neutral and later still uroselectan which is the sodium salt of 5-iodo-pyridon-2-acetic acid. Von Lichtenberg from a study of seven contrast media in over 2000 cases advocates a preparation—D 40—known as uroselectan B which can be used in much smaller doses gives a deeper shadow is less toxic reaches

its highest concentration in 15 minutes, and is eliminated in 15 to 30 minutes, it is shortly to be placed upon the market. Researches are now in progress with compounds of bromine, which are stated to be safer and less costly than those of iodine, and there is no doubt but that in the near future substances will be discovered still less toxic and yielding a denser shadow on radiography. This method of "excretion" or "intravenous" urography promises, therefore, to be of the greatest value to urology—it may, indeed, prove epoch-making.

The more usual "retrograde" or "ascending" pyelography necessitates ureteral catheterization, and thus intravenous pyelography has the advantage that it can be used where this is difficult or impossible, as in impassable obstructions of the ureter or urethra, in small contracted bladders, in severe vesical hæmorrhage, in children and especially in male children, and in cases in which ureters have been previously transplanted into the colon. Moreover, it yields bilateral pyelograms without the risk, inherent in the "retrograde" method, of conveying infection in septic and tuberculous cases, and thus settles the oft-debated question as to the propriety of simultaneous bilateral pyelography. Its routine employment will bring to light many otherwise unsuspected anomalies of the urinary tract—duplicate pelves and ureters, ectopic kidneys, etc.—while above all other advantages it has the outstanding merit of yielding some indication of the state of the renal function.

Intravenous pyelography must not, however, be regarded as a substitute for, but rather as complementary to retrograde pyelography, and if the renal function is so defective that the drug is not excreted in sufficient quantity to cast a recognizable shadow the latter will still be required. Both methods fail where poor renal function is combined with ureteral obstruction. The depiction of the normal renal pelvis on an "intravenous" pvelogram is decidedly different from that on a "retrograde" one. In the former, the pelvis fills physiologically from above while in the latter it is artificially distended from below. Intravenous urography has shown us that there is a definite systole and diastole of the

renal pelvis, and that in the normal state the pelvis is almost completely filled. The normal ureter exhibits active peristalsis which prevents it from being completely outlined, and presents definite sites of narrowing with intermediate dilatations, which might be interpreted erroneously as indicative of ureteral strictures.

RENAL BACK PRESSURE

Another principle to which Murphy constantly referred in his clinical teaching, and one, moreover, applicable to systems of the body other than the urinary, is that long standing pressure upon an organ or system should never be released suddenly, but always gradually. The evil effects of pressure are well known, and if this be brought to bear suddenly upon an organ it may lead to its rupture, or, short of that, to damage more or less irreparable. If, however, increasing pressure be applied slowly, so great is the adaptability of the human tissues to altered circumstances that compensatory mechanisms arise which delay, for a time, its injurious effects, although, unless such pressure sooner or later be alleviated, destruction of the organ or system is ultimately inevitable. If sudden relief be given there may follow such a repercussion as even to exceed in its noxious effects the original pressure, whereas gradual alleviation may lead to recovery, the completeness of which will vary inversely with the delay in its application. It can, in fact, be laid down as a general principle that the greater has been the pressure the more gradually should it be relieved.

Apart from the urinary tract this principle, as was pointed out by Sir W. de Courcy Wheeler,¹ finds its application in the relief of such pressure conditions as chronic obstructive jaundice, ascites, intestinal obstruction, pleuritic effusion, empyema, intracranial hypertension, hæmatocolpos, hydramnios, glaucoma, and back pressure upon the heart from disease and narrowing of the arteries. The best illustration, however, is afforded in the treatment of "back pressure" upon the kidneys such as occurs with a progressively increasing obstruction from the prostate gland.

Once the prostate gland whether enlarged or not commences to impede the urinary stream from that moment onward the whole of the urinary tract proximal to the prostate inevitably suffers. The bladder undergoes at first hypertrophy of its muscular wall and later dilatation the ureters next become dilated from below upward the back pressure is then thrown upon the renal pelvis which also in their turn are dilated next the calyces are similarly affected and pressure is thus reflected upon the renal tubules themselves leading to thinning of the renal parenchyma and finally to atrophy of the renal epithelium.

Doubtless the most important etiological factor in producing these results of back pressure is its restrictive effect upon the vascular supply of the kidney thus leads to defective nutrition of the renal tissues later to actual disorganization of the renal epithelium and finally to complete renal bankruptcy.

Clinical manifestations of these changes may not be apparent until they are well advanced since nature has granted us a fairly generous reserve of renal tissue over and above our actual necessities. In the later stages however we note a dry skin great thirst loss of appetite loss of weight nausea and even vomiting fairly constant headache the passage of large quantities of urine of a low specific gravity and much diminished urea content a low result from the urea concentration test and other tests of renal function and an increased blood urea content. If the back pressure continues unrelieved gradually increasing coma supervenes and heralds death.

These back pressure effects are seen in their most extreme form in those cases of silent distention of the bladder not infrequently associated with a small fibrous contracted prostate or with a small so called midlobe enlargement. I know of no less desirable type to have as a patient than this nor one whom if a surgeon were mainly intent upon being able to record favorable operation statistics he would more willingly hand over to the care of a professional rival. The patient falls into your consulting room feeling perfectly well and often looking so complaining only that

he makes too much water which is the layman's mode of expressing frequent micturition. The bladder is found to be distended to the level of the umbilicus or beyond yet without arousing in him the slightest sensation of distention his urine passed frequently and in very small quantities is but the overflow from the hugely distended bladder it is clear very pale with a urea content of 0.5 per cent or less while his blood urea may be from 100 to 300 milligrams per 100 cubic centimeters of blood or even higher. He scoffs at the idea that there is anything seriously wrong with him and yet notwithstanding he is on the very brink of uræmia. The immediate cause of his dangerous state is not the actual pathological condition of his prostate but the back pressure effects it has produced upon his kidneys hence our first concern is the release of the kidneys from such back pressure rather than the removal of the prostate—that is for future consideration.

This opens up the interesting question as to what should be our main reason as surgeons for ever recommending a patient to undergo the operation of prostatectomy especially if he be only in the early stages of his trouble. The patient's mind is concentrated upon the purely local effects—the difficulty and frequency of micturition etc.—and it is the removal of what he regards merely as nuisances that reconciles him to the radical operation. The surgeon however taking a much broader view of the present and future advises prostatectomy for a very much stronger reason than the removal of a mere nuisance he advocates it as a measure designed primarily to prevent progressive destruction of the kidneys. It cannot be too strongly emphasized that a patient with even a slight degree of prostatic obstruction cannot possibly have perfectly healthy kidneys from the first moment of obstruction the kidneys commence to suffer prostatic obstruction and healthy kidneys are as incompatible as are heat and cold.

If this renal back pressure be released suddenly as by completely emptying a chronically distended bladder at one catheterization then a characteristic sequence of events is frequently observed. The next urine that is

passed spontaneously or is withdrawn by catheter, contains blood, the hæmorrhage being of renal rather than of vesical origin. This hæmaturia may last for 2 or 3 days only, or it may continue to the end. The urine steadily diminishes in quantity and deteriorates in quality, the patient becomes increasingly drowsy, and all the signs of uræmia appear within about 14 days of the first catheterization—coma and death supervening shortly afterward. It is because of this comparatively long interval of from 12 to 15 days between the first catheterization and the fatal issue, that many practitioners fail to recognize the causal relationship of the one to the other. I well remember an enthusiastic house surgeon who, when I entered my wards one morning, proudly greeted me with the information that he had just withdrawn 80 ounces of urine from a case of prostatic obstruction, I recall also how his countenance changed from one of pleasure to one of pained and surprised incredulity when I gently hinted that he had possibly also withdrawn the man's only chance of recovery, and how, unfortunately, this proved so, since death from uræmia occurred on the fourteenth day. The risk of catheterization in chronic prostatic obstruction cannot be too strongly emphasized, it constitutes a risk considerably greater than that of many major abdominal operations, and one that should never be undertaken save under appropriate physical and aseptic conditions. The excuse of urgency cannot here be pleaded, as it might possibly be in a case of acute prostatic obstruction, since in chronic obstruction the patient is not in distress, and is usually quite unaware of the distended state of his bladder.

Sudden release of long standing back pressure upon the kidneys leads to congestion of the previously compressed vessels with consequent acute œdema of the renal parenchyma, this often proves to be the "last straw", it arrests the already seriously damaged functional capacity of the renal cells, renders the kidneys more susceptible to infection, and tilts the scale against the patient's recovery. On the other hand, if only the back pressure can be relieved so gradually as to avoid renal congestion and œdema, the renal function may then steadily improve, as evi-

denced by the disappearance of headache and thirst, a fall in the blood-urea, and a general amelioration in the various renal functional tests. Certain of the renal cells are so seriously damaged by the long standing back pressure as to be quite beyond repair, many others though considerably impaired are yet capable of varying degrees of recovery, while even under the most adverse circumstances a few cells doubtless escape entirely and may actively assist in the processes of regeneration and compensatory hypertrophy.

The various methods of effecting gradual renal decompression, many of which exhibit considerable ingenuity, need not be referred to in detail—the more gradually and continuously they act the greater their safety. Campbell¹ has shown that in cases of retention the sudden withdrawal of only 30 cubic centimeters of urine reduces the intravesical pressure by 25 per cent, and of 120 cubic centimeters by 50 per cent. It follows, then, that methods in which small quantities of urine are withdrawn at regular intervals are less safe than those where a slow continuous escape is permitted. My own preference is for a slight modification of the Shaw-Young apparatus², in the less severe cases a "dropper" such as that supplied with many apparatus for continuous proctoclysis, if attached to an indwelling catheter, allows control of the urinary flow.

In the most serious instances, however, and especially in those of that "silent" distention of the bladder to which I have already referred, decompression should commence with medical rather than surgical measures—rest in bed, warmth, vapor baths, milk diet, restriction of fluids, diaphoretics, and saline purges. When by these means the fundus of the bladder has been induced gradually to recede below the umbilicus, decompression may be continued with an indwelling catheter connected to the Shaw-Young, or other controlling apparatus.

SYMPTOMLESS HÆMATURIA

An important principle in urinary surgery is that hæmaturia should never be regarded

¹J Urol 19 - xvii 3-1

²J Urol 19 - xi 3-3

lightly. While hæmorrhage from other sources may not necessarily be of serious import—e.g. epistaxis bleeding from hæmorrhoids—hæmaturia is always of weighty significance and should invariably receive the closest attention. Fortunately for the diagnosis of its cause hæmaturia is usually accompanied by other symptoms of urinary disorder—pain frequency of micturition pyuria etc.—which assist in its interpretation. A very interesting group that of symptomless hæmaturia is constituted by those cases in which hæmaturia is absolutely the only symptom of which the patient complains indeed many of them volunteer the statement that had they been blind and so unable to detect the altered color of their urine they would never have known there was anything wrong. Sometimes however if bleeding is so profuse as to lead to the formation of clots pain may be caused by their passage along the ureter or urethra such pain is a side issue and not being dependent upon the actual cause of the hæmaturia does not remove the case from the class of symptomless hæmaturias.

Hæmaturia of this type may arise from diverse pathological conditions in fact any disease of the urinary tract may occasionally so first declare itself though with most of them this is very exceptional. In 1927 I analyzed 200 cases that had come under my own observation with the following results:

A. Th. hæm. t. na. wa. f. l. n. g. m. o.

1	All p. pull. ma.	76
2	M. lign. t. eopl. m.	3
3	Enl. rg. d. p. tat.	6
4	Simple l. t. ry. m.	1
5	App. d. la. bsc. d. jac. t. t. bl. dd.	3
6	Ul. rat. from. t. l. ft. fi.	1
7	Cal. l. fix. d. m. p. t. pro. tat. p. h.	1

B. Th. hæm. t. n. w. f. l. g. i. s.

1	Bl. ding. t. occurring. t. tum. f. xam. t.	
2	t. th. d. f. hæm. rth. g. d. ca. se.	
3	k. n.	3
4	M. lign. l. eoplasm. l. d. g. hyp. rn.	
5	phroma.	3
6	R. al. d. t. ral. calcul.	9
7	Esse. tial. d. p. thi. hæm. t.	8
8	Ch. ephritu.	3
9	M. bil. kid. y.	
10	P. pil. m. f. ren. l. pel.	
11	A. g. m. f. al. p. pilla.	
12	P. pillif. ro. ystad. ma. f. re. al. p. pilla.	
13	C. tal. cysti. k. d. y.	
14	R. al. t. berclus.	

Of the 170 cases of symptomless hæmaturia definitely traced to their origin 53 i.e. 31.1 per cent were due to malignant neoplasm and 86 i.e. 50.5 per cent to benign neoplasm. Of the renal hæmaturias of known origin 43 per cent were from malignant neoplasm while of the vesical hæmaturias only 25.1 per cent were associated with malignancy.

Essential or idiopathic hæmaturia is a purely clinical diagnosis indicating renal bleeding of unknown origin. Such a title merely cloaks our ignorance and is one against which every scientific mind must necessarily revolt. Murphy himself was very skeptical of the reality of idiopathic hæmaturia and he definitely stated that in his experience blood in the urine always indicated disease in the urinary tract. Yet in one of his clinical lectures he referred to a case in which Senator of Berlin had removed a kidney for extreme exsanguination from idiopathic hæmaturia and which on subsequent microscopic examination failed to reveal any cause for the hæmorrhage. Many of us must have had a similar experience. While a refusal to recognize the existence of idiopathic hæmaturia is therefore a stimulus to utilize every possible means of investigating its cause nevertheless the disquieting truth remains that a kidney may take upon itself to bleed and to bleed so furiously as to threaten death from hæmorrhage and necessitate nephrectomy for its arrest and yet its subsequent careful examination macroscopic and microscopic by a skilled pathologist may fail to disclose any abnormality whatsoever. I have met with three such cases and they certainly arouse the uncomfortable reflection that there is no very obvious reason why hæmorrhage should not recur from the remaining kidney though such has not occurred in my own experience yet it has been recorded by others—when further radical surgery is of course impossible.

In symptomless hæmaturia it is only by cystoscopy that the source of the hæmorrhage can be determined with certainty and this should be regarded as a matter of extreme urgency particularly if bleeding is actually occurring. If the hæmaturia be of renal origin it is only at this time that it can be traced to the defaulting kidney. Murphy constantly

insisted upon this point, and yet it still happens much too frequently that the practitioner's first efforts are directed, not to ascertaining the source of the bleeding, but to its immediate arrest, he puts the patient to bed and administers morphine and internal styptics. Although this course may allay the alarm which many patients not unnaturally feel at the discovery of blood in their urine, yet it may in the long run prove the greatest possible disservice, it is far preferable to allow the hæmorrhage to continue until arrangements can be made for a cystoscopic examination. Cystoscopy is here as urgently called for as is early laparotomy in acute abdominal crises, and if it be postponed until hæmorrhage has ceased it will probably fail, in renal hæmaturia to indicate its source.

When, through the cystoscope, blood has been observed to escape from one ureteral orifice only, a thorough investigation must be instituted by all the usual urological methods to ascertain the pathological lesion in the corresponding kidney, including careful palpation of the loin, a chemical, microscopical and bacteriological examination of the urine and possibly also of the separated urines after ureteral catheterization, radiography, and pyelography. By these measures positive evidence may be obtained of certain conditions, e.g., calculus, neoplasm, or tuberculosis, but when their findings are entirely negative the interesting question arises whether we are to treat the bleeding expectantly, as by the injection of a solution of silver nitrate or of adrenalin into the renal pelvis, the administration of calcium lactate, or the intramuscular injection of horse serum, or whether we should explore the kidney operatively. Those who advocate the latter do so mainly because of the fear that otherwise an early malignant neoplasm might be overlooked. Though I am aware that most American writers favor expectancy, my own inclination is toward exploratory nephrotomy, and only when this has been undertaken with a negative result do I care to label the hæmorrhage as "idiopathic" or "essential." It was exactly under such circumstances that the two earliest malignant renal neoplasms I have ever operated upon were discovered, and both these

patients are alive and well 8 years and 4 years respectively after nephrectomy. In carrying out this exploratory nephrotomy the kidney is exposed from the loin, and, along with the upper end of the ureter and renal pelvis, is examined carefully by palpation. If nothing abnormal is revealed the ureter is separated from the rest of the pedicle, which is then compressed by a rubber covered clamp to control hæmorrhage, and the renal parenchyma is freely incised a little posterior to its coronal plane until the pelvis and calyces are widely opened. If no macroscopic lesion be found, a small slice of the parenchyma is removed for microscopic examination, and the kidney is then carefully sutured with deep and superficial catgut sutures. The case is now regarded as one of "idiopathic" hæmaturia, and, should the hæmorrhage ever recur, it may be treated expectantly with the confidence that a malignant growth has not been overlooked, only when the bleeding returns so profusely as immediately to threaten life should further operative treatment, i.e., nephrectomy, be considered.

Renal sympathectomy, i.e., complete denervation of the vessels in the renal pedicle, of the pelvis, and of the upper inch of the ureter, has been suggested by S. H. Harris and R. G. S. Harris¹ of Sydney, in the treatment of "essential" hæmaturia, and in the one case in which they had performed this operation there had been no recurrence of bleeding for more than 14 months.

EARLY SYMPTOMS OF RENAL TUBERCULOSIS

One of the most characteristic features of Murphy's clinical teaching was the extreme importance he so consistently attached to an accurate account of the early history of the complaint under consideration, and especially to the order of onset of the respective symptoms and signs. Woe to that interne who, when called upon to read his notes of the case about to be demonstrated, had not the order of onset of the symptoms correctly stated very quickly, and often very facetiously was he called to account. Acute appendicitis furnishes the best example of the value of this accurate history, and Murphy's description of

the order of onset of its symptoms is one that will long remain classic. In the differentiation of renal conditions Murphy was equally insistent upon the value of the onset symptoms. In renal calculus it is pain that is expected. In neoplasm it is hæmaturia. While in renal tuberculosis it is increased frequency of micturition. He pointed out that when tuberculosis starts in the parenchyma the order of onset of the symptoms is first increased frequency of micturition unassociated with any increase in the amount of urine though later polyuria supervenes, second an increased number of leucocytes in the urine scarcely worthy of the designation pyuria and third hæmaturia. If however the tuberculous process commences in the mucosa of the renal pelvis these three symptoms—dysuria, pyuria and hæmaturia—commonly appear simultaneously.

The subject of renal tuberculosis had a profound personal interest for Murphy. For in 1883 while a post graduate student in Vienna he had a sharp attack of hæmaturia which a Viennese professor whom he consulted ascribed to tuberculosis of the right kidney. He was on that account advised to leave Europe. The hæmaturia soon ceased and never recurred nor is there any record of the tubercle bacillus ever having been found though throughout his life he had slight transitory albuminuria after great exertion or following any special mental strain. Casts were never seen and only occasionally a red blood cell. He always considered this albuminuria to be of the fatigue type analogous to that found in young soldiers after a forced march. At the autopsy upon Murphy which he had himself requested should be made his right kidney was found to be very small measuring only 3 by 2 by 2 centimeters with the pelvis and ureter still patent. Histological examination disclosed considerable proliferation of the connective tissues with some proliferation of the endothelial cells of the capillaries and the production of new capillaries. There were no giant cells. The opinion formed was that the condition represented a chronic persistent infection of the right kidney due probably to some organism other than the tubercle bacillus. The left kidney was considerably enlarged having undergone compensatory hyper-

trophy. The cause of death was anæmia pectoris from atheroma of the coronary arteries and this was regarded as an infection metastasis from the 33 year old infection of the right kidney. His friend Dr W A Evans has expressed the opinion that had the right kidney been removed in 1883 or at any time within 5 years after the arthritis would have been prevented.

The evolution of our knowledge of urinary tuberculosis particularly the great progress made in its earlier recognition constitutes one of the most interesting and beneficial advances in urology that have occurred within our time. Regarded at first as primarily of vesical origin and in consequence as being beyond the scope of radical surgery the disease ran its course practically uninfluenced by treatment. The pain and frequency of micturition steadily increased to such an extent that toward the last life became almost one prolonged and painful act of micturition from which death could not be regarded as other than a most merciful release. It was from the cystoscope we learned that even in fairly advanced cases ulceration was definitely more marked around one of the two ureteral orifices and that at an earlier stage it was limited thereto or even absent. This led to the discovery that the bladder was not the initial site of the disease but that it was attacked by extension along one of the ureters from a primary focus in the corresponding kidney. Timely removal of that kidney it was soon learned could prevent the spread of the disease to the bladder. Our present day ability to recognize the existence and often also the extent of tuberculous change in a kidney from the cystoscopic appearance of the corresponding ureteral orifice and thus we owe largely to the work of my fellow countryman E Hurry Fenwick always appeals to me as the most fascinating of the cystoscopic innumerable and priceless contributions to urology.

In spite however of considerable progress in the early diagnosis of renal tuberculosis we are not yet in a position to recognize it with any certainty until it has invaded the renal pelvis. So long as the changes are confined to the parenchyma renal tuberculosis remains one of the silent diseases and we are not

infrequently astounded at the advanced destruction of the kidney that may occur before that "silence" is broken. In visceral tuberculosis, considerable importance was attached by Murphy to the slight constitutional disturbances which precede the local manifestations. "Whenever you get a history of gradual deterioration of the general health of a patient, the first question you should ask yourself is 'Is this the initial stage of a tuberculosis?'"

Murphy considered renal tuberculosis to be usually a hæmatogenous infection, the bacilli entering the blood by way of the lymph stream from a primary focus in the bronchial glands. He admitted, however, the occasional occurrence of an "ascending" infection along the ureter from the bladder, prostate, seminal vesicle, or epididymis, and rarely, infection by extension from the perinephric tissues. He believed (1) that in visceral tuberculosis tubercle bacilli may be found in the urine even in the absence of a tuberculous focus in the kidney, (2) that in the great majority (80 to 90 per cent) of early cases the disease is unilateral, and (3) that early cases can be cured by non-operative measures, prominent among which he placed the injection of tuberculin.

In the first and second of these beliefs, Murphy was in accord with the views prevalent at that time, but, with regard to the third, most authorities then taught that chronic renal tuberculosis, if left to run its natural course, inevitably advanced to complete destruction of the kidney and progressive involvement of the rest of the urinary tract, arrest of this extension could be achieved only by the surgical operation of nephrectomy, or by nature's operation of "auto-nephrectomy," i.e., the isolation of the affected kidney from the rest of the urinary system by progressive thickening and, finally, complete obliteration of the lumen of its ureter.

In the 15 years that have elapsed since Murphy's death, although considerable discussion has ranged around these same three questions, and much clinical and experimental investigation has been carried out, no general agreement has yet been reached. Many recent workers, Dyke and Lepper, Medlar, Helmholtz, Thomas and Kinsella, Bumpus and Thompson, Harris and others, now hold (1)

that "secretory bacilluria" does not exist, and that the presence of the tubercle bacillus in the urine from a kidney denotes the actual existence therein of a focus of tuberculosis, even though microscopic only, (2) that renal tuberculosis is at first a bilateral condition, and (3) that the initial renal lesions frequently heal. Wildbolz, of Berne, however, whose right to speak with authority upon renal tuberculosis will be universally admitted, in an address to the American Urological Association at Chicago in June, 1928, adhered very strongly to the older views. He maintained that "secretory bacilluria" is a reality, and that tubercle bacilli may pass through the kidney and appear in the urine without producing any macroscopic evidence of tuberculous tissue change and without causing the admixture of pus with the urine. Further, he expressed himself convinced that chronic renal surgical tuberculosis as met with clinically is primarily unilateral, and shows no tendency to heal.

In spite of these divergent views the surgical position of today does not differ materially from that of Murphy's time. Renal tuberculosis, if clinically unilateral, should be treated by nephrectomy, whereas in clinically bilateral involvement nephrectomy should be performed only very exceptionally, as when there is severe pain, hæmorrhage, or acute sepsis in a tuberculous kidney, whose fellow is but slightly affected.

Whether the whole of the ureter or part only should be removed along with the kidney has been much discussed. Though I am well aware that many good results have followed nephrectomy with the excision of only so much of the ureter as could be reached readily from the lumbar incision, yet my own practice is to excise the whole ureter and kidney together in one unbroken piece, first exposing the ureter extraperitoneally through a "grid-iron" incision in the iliac fossa, freeing it and dividing it with the electric cautery at its entrance into the bladder, and then removing it along with the kidney and as much as possible of the perinephric fatty tissue through a second incision made in the loin. After this procedure I believe that the symptoms, particularly the frequency of micturition will be

more quickly relieved than when any portion of the tuberculous ureter is left behind

CONSERVATISM IN UROLOGY

The principle of the conservation of such portions of a defective organ as are still capable of further efficient function appealed forcibly to Murphy who moreover always taught that only the minimum of trauma necessary for the actual fulfilment of its purpose should be inflicted upon the tissues in the course of a surgical operation. This is well illustrated by his attitude toward the surgery of renal calculus. In the early period of operations for this condition the stone was extracted through an incision often of considerable extent in the convexity of the renal parenchyma. This entailed a varying degree of trauma to the renal tissue, was sometimes attended with profuse hemorrhage and carried with it a definite risk of a subsequent fistula. To minimize these drawbacks Murphy from 1890 onward adopted the method of extracting the stone through an incision made directly into the renal pelvis (pyelolithotomy) which he afterward closed by suture. He had a profound respect for the healing powers of the renal pelvis and of the ureter and considered that wounds of these structures heal more readily than those of any other tissue in the body with the exception of the peritoneum. This operation of pyelolithotomy has since become the generally accepted procedure for renal calculus and where it is impracticable as when the calculus is situated in the cortex and especially when multiple one or more small cortical incisions made with due regard to the direction of the main arterial branches have replaced the free coronally placed incision of former times. Only when the renal parenchyma has been very extensively destroyed or where there is very severe accompanying septic infection ought nephrectomy to find any place now days in the treatment of renal calculus.

The frequency of recurrence of renal calculus after operative removal is difficult to estimate since there is no doubt but that as in the analogous case of gall stones many so called recurrences are really left-overs from the previous operation. This overlooking of a

stone during pyelolithotomy or nephrolithotomy and the leaving behind of fragments of calculi or of particles of calculous debris are two of the most important etiological factors in recurrence. The former can be avoided by fluoroscopy of the kidney exposed in the wound as advocated by Braasch¹ or by radiography of the kidney and rapid development of the film before closing the wound as recommended by Quinby² and others. Careful lavage of the pelvis and calyces with saline solution especially if combined with the use of a suction apparatus will assist in the removal of fine calculous particles. In view of the important part that infection play in the etiology of renal calculus careful search should be made in other regions for any septic focus any such should if possible be thoroughly eradicated or if this be impossible its effect must be minimized by careful antiseptic treatment both before and for a prolonged period subsequent to operation.

Postoperative treatment by urinary antiseptics including if necessary renal lavage should be continued until the urine becomes sterile. As in so many other surgical conditions the actual operation is only one—the starting-factor in the treatment of the patient by appropriate after care alone can the frequency of recurrence of renal calculus be minimized.

It is in connection with *hydronephrosis* that conservative surgery has scored its most pronounced successes. Pyelography in combination with the various tests of renal function can furnish us with a fairly accurate estimate of the degree of distention of the pelvis and calyces and of the functional capacity of the renal parenchyma—both data of prime importance in deciding whether conservatism is worth the attempt. It has been frequently stated that excessive mobility of a kidney may itself by kinking the ureter produce hydronephrosis in my experience however there has invariably been some other factor in association such as a congenital or an inflammatory stricture at the ureteropelvic junction bands or adhesions distortin the ureter into valvular form or an aberrant blood

vessel connected with the lower pole of the organ and over which the upper end of the ureter has become strongly angulated Murphy, with his intense faith in the reparative powers of the ureteral and pelvic tissues, dealt with these cases not only by wide excision of valved or strictured segments and the subsequent re-implantation of the ureter into the most dependent part of the pelvis, but he also resected very freely the redundant pelvic wall so as to reduce it to approximately normal dimensions

Obstruction from kinking of the ureter over an aberrant blood vessel can be relieved by division of the latter between two ligatures. If large, however, its severance may lead to atrophy of a considerable area of the renal parenchyma, and it may prove more truly conservative to preserve the vessel and to section the ureter instead, reuniting the divided ends well away from the constricting vessel, as advised by Quinby¹. Owing to the difficulty in suturing so small a tube as the ureter Patch² prefers to divide the pelvis just above the ureteropelvic junction, rather than the ureter itself, thereby obtaining much broader surfaces for reunion after the ureter has been freed from constriction.

The conservative tendency of modern urology is further noticeable in a consideration of the surgical aspects of *developmental anomalies* of the urinary tract. Largely on account of the complexity and intricacy of its embryology the urinary system, above all the other systems of the body, is peculiarly liable to abnormal variation. Recognized at first only at autopsy as interesting embryological diversities, and at a later period discovered accidentally during the course of abdominal operations, it is only since the general adoption of modern methods of urological investigation, more especially of urography, that the comparative frequency of these abnormalities has become known, their relationship to coexistent lesions of the urinary system established, and appropriate measures taken, in certain cases, for their relief. It seems highly probable that in the near future the recently introduced "intravenous" method will very materially

extend the routine use of urography, and that our knowledge of these anomalous conditions will be correspondingly increased. A large proportion of them do not in any way interfere with perfect body function and their only clinical importance is their possible effect upon coexistent pathology, on the other hand they may occasionally be the source of much distress, as when a misplaced ureteral orifice, opening into the vagina or urethra leads to incontinence of urine. Unilateral kidney, and the single "fused" kidney can nowadays be recognized with certainty by cystoscopic and pyelographic methods, and that most terrible catastrophe of past times—the removal of an only kidney—safely averted. Supernumerary, polycystic, and horseshoe kidney can all be demonstrated pyelographically, as can also the multiplicity and diversity of situation, almost bewildering in their complexity, of the ureters and renal pelves. The increasing frequency with which, where disease affects one half only of a duplicated kidney, heminephrectomy is nowadays performed, augurs well for the future of conservative urology. Even in solitary kidney, as shown by Walters and Wright³ timely operation, and even repeated operations can be undertaken under modern urological conditions with good prospect of success.

In *tuberculosis of the epididymis*, Murphy was a forceful advocate of the conservative operation of epididymectomy as opposed to castration. He wrote "There is no more occasion for taking out the testis proper in the early stage of tuberculous epididymitis than there would be for taking off the caput coli if you had a case of appendicitis. The testis can be saved if you operate in time." He believed emphatically that genital tuberculosis in the male always starts in the epididymis, most frequently in the globus minor, and that it spreads thence along the vas deferens to the vesiculæ seminales, prostate, and base of the bladder. The treatment Murphy recommended was the removal of the epididymis and as much of the vas as could be reached from the groin, he never excised a seminal vesicle, and shortly before his death stated that he had never seen a case presenting

¹J. Am. M. Ass. 19 7 1000 841

²Brit. J. Urol. 29 9 1 373

³Surg. Gynec. & Obst., 1930 41 836

clinical evidences of tuberculous involvement of a seminal vesicle that did not entirely heal after epididymectomy without further operation. These views as is well known are strongly opposed by Young who considers tuberculous infection of the epididymis to be secondary to that of the seminal vesicles. On this opinion he bases his radical procedure in genital tuberculosis of excision of both seminal vesicles ampullæ and lateral lobes of the prostate together with the whole of the vas and the epididymis on the affected side. Young and Murphy both agree however in protesting emphatically against the unnecessary removal of the testis which hitherto has been so frequently practiced.

Further evidences of the present day healthy conservative reaction in urology are shown in the greatly diminished number of operations that are now performed of nephropexy of renal decapsulation and for the cure of varicocele. Calculi are now frequently removed from the lower portion of the ureter by endoscopic methods. ureteral transplantation has replaced nephrectomy after accidental injury of the ureter during surgical operation and there is an increasing tendency to adopt punch operations high frequency electrosection or other methods of less severity than prostatectomy in the management of certain types of prostatic obstruction. Owing to the earlier recognition of strictures of the urethra and the more effective employment of dilatation in their early treatment the operations of external and internal urethrotomy are much less frequently required while the endoscopic application of diathermy to benign vesical neoplasms and of radium to those of a malignant nature must have materially reduced the number of suprapubic cystotomies that otherwise would have been performed.

PROSTATECTOMY

In his earlier work in the field of radical prostatic surgery Murphy removed this gland by the perineal route. Later inspired by the Italian surgeon Bottini who in 1876 had commenced to treat prostatic obstruction by division of the bar or the enlarged middle lobe with a thermo-alvanic cautery passed *per urethram* Murphy treated several cases by

division of these structures with the thermocautery not blindly however through the urethra as did Bottini but under direct vision after exposure by suprapubic cystotomy. The results were not encouraging and he returned to perineal prostatectomy which at that time he considered preferable to the suprapubic operation. Thus in 1902 he wrote "Suprapubic prostatectomy should be limited to exceptional cases of enormous intravesical enlargement of the prostate. The perineal operation is the most direct and the least bloody." In 1903 he recorded 32 cases and in the following year 51 cases with only one death. From this time onward however Murphy seems to have regarded the suprapubic route with steadily increasing favor and shortly before his death in 1916 he stated "We remove all our prostates by the suprapubic route. If however we have a superlatively small prostate in a thin man we perform the perineal operation."

This gradual change in Murphy's attitude toward perineal prostatectomy is typical of that of the majority of surgeons whose work has covered approximately the same period and the oft debated question as to the relative merits of perineal and suprapubic prostatectomy would appear to have been settled for the present at any rate in favor of the latter. Nevertheless you have in this country the world's greatest perineal prostatectomist in the person of Dr. H. H. Young the very arch protagonist of the operation itself. Of all the surgical operations I have witnessed in the course of my travels the most perfect anatomical and surgical demonstration was one of perineal prostatectomy performed at Baltimore by Dr. Young. Every step was exquisitely shown and to the onlooker it could appear only in keeping with the general fitness of events that Dr. Young's mortality for this operation is the smallest on record. At the hands of the average surgeon however and not of a super surgeon perineal prostatectomy carries with it the two dangers of wound of the rectum and of defective sphincteric control and these combined with the greater ease of performance of the suprapubic operation account for the present day preference for the latter.

Looking back upon the question, so heatedly debated during 1902-3 of the priority of performance of suprapubic prostatectomy, it is interesting to note that Murphy believed the honor to belong to W T Belfield of Chicago who was, he states, the first to follow a deliberate plan for the removal of a mid-lobe of the prostate through a suprapubic incision. He performed this in 1886, and published the case in the following year. That it was deliberately planned, and was not, as G Buckstone Brown had suggested, an accidental occurrence, was well known to other surgeons in Chicago. McGill, of Leeds, without knowledge of Belfield's work, some 3 years later described a similar procedure based on an experience of 24 cases, and laid down more definite indications for its performance. The operations of Belfield and McGill were, however, partial procedures, and the first complete suprapubic prostatectomy appears to have been carried out by Eugene Fuller, of New York, in 1894. To Freyer, of London, must be accorded the credit of bringing the operation into the prominence it has since enjoyed, and this in spite of the fact that both his main original contentions—that he removed the entire prostate in its capsule, and that he left the prostatic urethra behind—have since been completely disproved. Murphy and others recognized that in the wall of the cavity remaining after suprapubic enucleation of the prostate there were compressed and atrophied remnants of prostatic glandular tissue, and that the operation was not, therefore, a complete prostatectomy. That the prostate can be totally removed with its capsule was acknowledged by Murphy who rightly stated, however, that it should never be undertaken except for malignant disease.

As to the time at which a patient should be advised to undergo prostatectomy Murphy considered that radical operation should be performed whenever, otherwise, catheter-life must be entered upon. He was led to this view by the impossibility of avoiding infection whenever the catheter has to be used over a prolonged period of time. He wrote "You do not interfere with the prostate solely because it is enlarged. The moment a man begins catheter life, no matter how cautious

you are as to asepsis, no matter how well the catheter is used, it is only a question of time when the patient will have an infection of the bladder from the use of that catheter. Antiseptic precautions count for nothing. Urethritis from the use of the catheter, and sepsis of the bladder are bound to occur sooner or later." Most surgeons of the present day will fully endorse this opinion.

Risks of operation. When, at the close of the last century, prostatectomy came into vogue it was at first attended with a high mortality. This was due mainly to the operation having been performed in cases which would nowadays be considered quite unsuitable, and without proper regard to the state of the renal function—renal insufficiency being the most frequent cause of death. The general adoption of careful tests of the renal function before submission to prostatectomy, the postponement of the operation where these tests indicate defective function beyond the limits of safe operability, and the preliminary relief, in such cases, of any back pressure upon the kidneys by the institution of urethral or suprapubic drainage until such time as the renal function improves to within safe limits—all these factors have shared in steadily reducing the death rate of prostatectomy from renal insufficiency, while concurrent improvements in technique, particularly in the control of hæmorrhage, have lowered still further the general mortality. Renal insufficiency and hæmorrhage being thus deposed from their pre-eminence as mortal factors, it would appear that infection is the hazard most to be dreaded at the present time. Not until as much attention is paid to this danger as has been expended upon that of renal insufficiency can we hope for a further substantial reduction in the operative risks of prostatectomy. This infection may manifest itself as a localized sepsis of the operation wound, the prevesical space, the prostatic cavity, or of the epididymis, or it may assume a more general form—that of septic pyelonephritis. The more local manifestations should prove capable of prevention, once their importance as factors in mortality is recognized. The avoidance of any accumulation of fluid in the bladder by the use of a continuous or intermittent

suction apparatus continuous antiseptic irrigation of the prostatic cavity and its more effective drainage through a counteropening in the perineum or ischioanal fossa as advocated by Fullerton of Belfast are all factors tending to minimize sepsis. Whether the same can be said of the method of primary suture of the prostatic cavity advised by Harris² of Sydney further experience alone will show.

Murphy constantly drew attention to the risks of infection of the prevesical space and laid great stress upon the importance of suturing the lower angle of the incision in the bladder as soon as this is made to the abdominal wall thereby preventing the prevesical space from being widely opened up during the subsequent steps of the operation. Moreover he invariably drained this space whether he closed the bladder completely or not.

Epididymitis. Although epididymitis may occur in association with enlarged prostate quite apart from any operative procedure and may also arise during the period of preliminary urethral or suprapubic drainage of a two stage prostatectomy yet it is the occurrence of this complication subsequent to the removal of the prostate that especially interests us. Its frequency has been variously estimated. Thus H. P. W. White³ on examining 50 consecutive cases that had survived prostatectomy at St. Peter's Hospital for Stone, London, found definite evidences of inflammatory change in the epididymis in 33 per cent, all of which occurred after the one stage operation. Randall⁴ found epididymitis in 2 of 100 consecutive prostatectomies and Alyet⁵ in 39 per cent of his private ward and in 20 per cent of the public ward patients. The incidence of postoperative epididymitis is in reality greater even than these figures suggest since this complication may not occur until several weeks or even months after patient leaves the hospital; moreover a tendency to recurrence is occasionally encountered and in one of my

patients operated upon 9 years ago recurrences of epididymitis still take place.

Acute epididymitis is not only a painful and distressing annoyance to a patient but it lowers his general resistance, delays the healing of the tissues, necessitates the removal of an indwelling catheter and compels the temporary cessation of any further urethral instrumentation. Though only in about 10 per cent of cases does it proceed to suppuration yet it is a potential cause of septicæmia or pyæmia and its prevention is therefore extremely desirable.

Of the possible routes of infection from prostatic cavity to epididymis although conveyance of organisms by the blood stream cannot be denied and although as some believe the lymphatics of the cord may occasionally be concerned yet in the vast majority the infection is undoubtedly carried along the vasa deferens. Ligature of the vas or better still section and ligature can therefore be relied upon to prevent epididymitis provided that it be performed before the organisms have reached the epididymis. Murphy recognized this and whenever the history disclosed a former epididymitis however mild he always performed bilateral vasectomy as a preventive measure immediately prior to removing the prostate; he does not appear however to have adopted it as a routine procedure.

Proust in his perineal operation routinely ligatured the vasa deferentia just above the prostate and Albarran also ligatured the vas in either groin.

Since 1922 I have employed bilateral vasoligation routinely in all my prostatectomies and my previous incidence of 22 per cent of epididymitis has completely disappeared—I have not met with a single case in 177 prostatectomies since adopting this preventive measure. I expose the vas on either side through a small incision in the groin, divide it between forceps and ligature each end. This is done at the time of operation in a single stage prostatectomy or at the first step of a two stage procedure. Sooner or later one will assuredly come across a case where organisms have already reached the epididymis just prior to the vasoligation so that epididymitis will occasionally occur in spite of this pro-

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cedure, so far, fortunately, I have not met with this. On a few occasions, however, the small wound in the groin, after having healed primarily has broken down and discharged for a few days, the infection having, obviously, travelled along the vas to the upper ligature, but having been prevented thereby from reaching the epididymis.

If, then, a timely vasoligation can prevent epididymitis, would it not be better to perform this at the earliest opportunity and thus avoid the possibility of pre-operative epididymitis—a condition at least as harmful as postoperative? For this reason Alyea¹ advocates the ligation of the vasa of all cases of prostatic obstruction on their admission to the wards. He accomplishes this without any anaesthesia, by a very simple "closed" technique, which he is satisfied leads to complete occlusion of the vas.

There can be no objection to vasoligation from the point of view of future sterility, since, in any event the patient after prostatectomy will almost certainly be sterile, though not necessarily impotent. Indeed, if there be any truth in Steinach's contention that vasoligation, by causing proliferation of the cells of Leydig and a greater output of testicular hormone leads to "rejuvenescence," then the patient will gain additional benefit.

Recurrence of prostatic hypertrophy A rather disquieting feature in connection with prostatectomy and one which is becoming increasingly manifest is the possibility of a recurrence of the prostatic hypertrophy many years after successful operation, even though there has been complete relief in the intervening period. Several such cases have now been recorded by operators of considerable experience, where there can be no doubt but that the operation really was a "radical" enucleation, as proved by the preservation of the specimen thereat removed. There is no question of malignancy having supervened, and the recurrent prostate is, like the original, of the fibro-adenomatous type. Possibly the source from which the prostate has been regenerated lies in the compressed and atrophied gland tubules whose presence has been demon-

strated microscopically, in fatal cases, in the wall of the cavity remaining after enucleation of the prostate. More probably, however, the new prostate arises from small adenomatous nodules that are not infrequently left behind during prostatectomy, and to prevent this the prostatic cavity should always be thoroughly searched for such remnants.

Time does not permit me to refer in detail to other interesting features of Murphy's work in urology. His emphatic caution against the performance of nephrectomy in renal sarcoma, based on his experience that recurrence in the opposite kidney inevitably follows, his "fist-percussion" test for tension within the renal capsule, his observation that when a kidney, the seat of neoplasm, is repeatedly palpated bimanually a trace of albumin and some red blood cells almost invariably appear in the urine—a test of especial value where previously there has been no urinary change, his insistence that in all plastic operations involving the urethra the urinary stream be diverted from the area of operation throughout the stage of healing, his advocacy of the free mobilization of the urethra prior to the resection of traumatic strictures, and many others.

I trust, however, that enough has been said to indicate that, as in other fields to which your previous orators have drawn attention, so in this field of urinary surgery Murphy held a foremost place and was, in many respects, a pioneer.

Let us then bestow all honor upon one whose breadth of vision and whose boundless energy were such as to enable him to enrich in so many directions and to such a profound extent that science and art which it is the prime purpose of this College to promote. And the honor that we confer is no mean honor, for to have one's life and work recalled and reviewed at each clinical congress of the American College of Surgeons—the largest in the world—is an honor that will last so long as your great Nation shall last, and that, my friends, gives every promise of being coeval with life upon our planet itself. Surely, then, to confer such an honor is to confer, in very truth, fame immortal.

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THE PRESENT STATUS OF CARDIAC SURGERY¹

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SURGERY of the heart must seem to some a singular topic to find its place in such an important meeting, especially since so few here can have any active interest in this field. At the same time the American College of Surgeons is erected largely for its educational value and it may be that certain recent advances in this relatively unexplored field will create in some here to night sufficient stimulation to enlarge the small group already actively engaged in attempting to extend the domain of surgery in this direction.

Cardiac surgery for our purposes may be divided into (1) the treatment of injuries of the heart (2) the surgical treatment of acute and chronic pericarditis (3) the surgical treatment of angina pectoris and (4) the surgical treatment of mitral stenosis. I have let these divisions of this field follow one another in the order of their development. This order may also reflect their relative importance. Certainly surgery is the only treatment for wounds of the heart whereas there may be serious objection to the as yet unproved contention of those who support surgery as a means of therapy in mitral stenosis.

We cannot at this time discuss all the background upon which our present accomplishments rest but it will not be amiss to point out that the surgeons in this special field owe a debt to all types of medical investigators. The steps which have led to a better understanding of the dangers of an open pneumothorax comprise but one phase of this problem and the experiments of that inquisitive ophthalmologist Becker who in 1872 was the first to create valvular insufficiency experimentally put us under a special debt to the earliest of surgical specialties.

1. *The treatment of injuries of the heart and pericardium.* Surgical therapy in the general field of trauma needs no particular defense. It is the only treatment possible. In this special field as in others injury through its urgency has been the initial stimulus for sur-

gery. Wars if of no other use to man have always carried forward this branch of medicine. Both Pare and Hunter owe a great debt to war and there are many here to whom certain mysteries of our bodies were disclosed under the urgent stimulus of battle conditions. The initial information and stimulus obtained under field conditions needed great elaboration before surgical therapy even in trauma could be approved. This is seen in the hesitancy with which Larrey in Napoleon's day approached wounds that infected the pericardium. Anesthesia had to be developed and technical surgery improved to a high degree. But the stimulus received in war soon reached to laboratories and experimental endeavor readily showed how well the cardiac muscle would heal and how best to control the beating heart during suture. The final step in an understanding of this field came with the realization of the physiological effects of an increasing intrapericardial pressure. Riouan in 1649 Morgagni in 1761 and Jobert in 1839 had described the dangers of an increased intrapericardial pressure but it was not until 1884 that the investigations of Rose pointed out the great significance of this condition. Before cardiac tamponade was understood cardiac surgery could not progress. Thus in any case of a wound of the heart which can survive long enough to hope for medical care the matter of chief importance is the intrapericardial condition. A wound of the heart due to a small pointed instrument such as killed the Empress Elizabeth of Austria in 1898 becomes a serious condition because of the mounting intrapericardial pressure as blood leaks from the ventricle but finds itself trapped in the pericardium. Once the intrapericardial pressure equals venous pressure the heart fails to fill and its output is correspondingly endangered.

Wounds of the heart need immediate surgical attention but the surgeon who would attempt repair must have a complete understanding of the condition he will encounter

Even in the most desperate cases he must be prepared for the almost immediate revival of a normally acting heart, once the intrapericardial pressure is relieved by a surgical opening. In the swirl of foaming blood he must accomplish closure of the opening into the heart without infringement of the coronary supply to the cardiac muscle or the flow of blood to and from the organ. Since complete anoxæmia is tolerated with safety for perhaps one minute, massive strangulation of the organ for the purpose of suture is contra-indicated. Methods for the exposure of the heart and the placement of such sutures as will be necessary without gross strangulation have been suggested from our clinical and laboratory experience. In brief this consists in the use of a stitch in the apex of the heart to deliver and hold the organ, and a finger on the opening to stay the loss of blood while control mattress sutures are placed which later approximate the opening until the final sutures are tied. Since any wound that the surgeon will see must of necessity be small, because the greater ones are immediately fatal, this latter method should suffice for the accomplishment of the ordeal without the loss of that equanimity so necessary in any serious surgical procedure.

Today the surgical treatment of wounds of the heart is the accepted therapy for this dilemma. In spite of the fact that no single surgeon can acquire great experience in this matter, the statistical study of results should give to the individual operator considerable confidence. The first attempted suture of a wound of the heart in a human being was by Cappelen of Christiania in 1895. Within 10 years a statistical study revealed 38.75 per cent recoveries in 160 cases. These figures have steadily improved. Tuffier, in 1920, compiled a total of 305 cases with 50.4 per cent recoveries. Ballance, in 1920, using only cases between 1912 and 1920, found 152 cases with 68.4 per cent recoveries. And in a study, made by us in 1926, of cases operated upon between 1920 and 1926 there were 28 cases with 78.6 per cent recoveries. Here then is a field for surgical endeavor in which the mortality is about 25 per cent. Moreover, this field not so long ago was considered beyond the limits of medical care. Perhaps this branch

of cardiac surgery alone justifies the presentation of today.

2 *The surgical treatment of acute and chronic pericarditis.* This field for surgical endeavor is also an accepted one and has its natural dependency on the emergency surgery of trauma. Wounds involving the heart are in most cases infected and it was natural that even the barber surgeons should have given them some care. It was only, however, after the real functions of the pericardium were unraveled by physiologists and pathologists that an intelligent, direct attack upon the disorders of this covering could be contemplated.

The surgical drainage of *acute pericarditis* needs no elaboration here. It is a simple procedure performed under local anæsthesia requiring usually the removal of one or more costal cartilages and depending largely for its success upon the dependency of the drainage. Studies made in our laboratory indicate that irrigation of the infected pericardial cavity with solutions other than physiological salt solution is undesirable. Dakin's solution in particular not only interferes with the conduction system but produces an adhesive pericarditis. Pericardiostomy should be carried out in all cases of suppurative pericarditis. The real problem here is our ability to make a proper diagnosis, and the statistics of Dr. E. A. Locke, who found that in 150 cases at the Boston City Hospital the diagnosis was made in only 17 per cent of the proved cases, are typical of the figures elsewhere.

Chronic pericarditis presents a much more interesting field. This condition has many variations, for the inflammatory reaction may be confined to the pericardial sac or involve the mediastinum and neighboring structures. In its most advanced form it glues the heart to the pericardium and this sac in turn to the bony cage. Thus, with each heart-beat the heart must move the thoracic wall or twist upon itself. In any degree of adhesive pericarditis the circulation is seriously interfered with, and in these cases the patients as a rule consult physicians with the ordinary complaints of those with circulatory failure. Here again our diagnostic acumen is challenged, for in the few cases submitted to surgery almost miraculous relief has been given.

Brauer of Marburg in 1901 led the arguments for the surgical relief of this condition and under his direction surgeons removed the overlying ribs which were impeding free cardiac motion. In some cases this simple procedure alone gave great improvement. But more elaborate study has shown that in many cases the cardiopericardial adhesions are very dense and even filled with calcareous deposits are more of a deterrent to the cardiac motion than the thoracic wall adhesions. As long ago as 1898 Delorme had suggested removal of the adherent pericardium itself. This operation of decortication of the heart is now an accepted procedure. It has been utilized and fully described in this country by my associate Dr. C. S. Beck and by Dr. E. D. Churchill of Boston. In my own clinic we have naturally an interest in this field and Dr. Beck has devoted a great deal of time in both the laboratory and clinic to this problem. His researches into the experimental production of adhesive pericarditis have conclusively shown that the Pick syndrome of polyserositis is produced in animals when an adherent pericardium is established. Moreover the picture even of the thickened Glisson's capsule occurs in animals in which the condition is fully established. These studies also seem to indicate that the accumulation of fluid in either the thorax or the abdomen is dependent upon whether the right or left heart is impeded. This is a very important matter and explains certain clinical variations in the disease. Moreover it suggests that proper clinical study may tell us just how widespread the disease is and upon which portion of the pericardium surgical attack should be aimed. Finally it seems to be the opinion of those investigators and surgeons best qualified to speak upon this matter that the operation of decortication should be the operation of choice in almost all cases of adherent pericardium. Indeed it would appear that the very simplicity of the Brauer operation of cardiolysis has deceived many and has failed to bring relief in cases where the operation of decortication would have yielded great relief. In addition the Brauer operation tends to bring the heart into closer relation with atmospheric pressure which has been

shown to be undesirable. These suggestions and this criticism of the Brauer operation are largely the results of Dr. Beck's experimental work and his careful clinical studies.

We have had the opportunity to see the brilliant results occurring from pericardiectomy, a bedridden orthopneic waterlogged boy of 14 years restored to an active life. As I look back upon my short experience in medicine this case is today one of the most outstanding examples of the restorative powers of intelligent surgery.

3. *The surgical treatment of angina pectoris.* Surgical therapy in angina pectoris is based on the hypothesis that the stimuli which give rise to the symptom pain arise in the heart and are carried by some nervous pathway to the spinal nervous system where these impulses overflow and stimulate the somatic sensory neurons supplying the upper thorax, arms and neck. The surgical act is aimed at division of this nervous arc thus preventing the patient from recognizing the symptom pain. As the pathological condition which causes angina pectoris is still unknown there is no intention of eradicating the disease by surgery. It is a method of treatment which is purely symptomatic and therefore identical in purpose with the division of the sensory root to the gasserian ganglion in cases of trifacial neuralgia.

The operative treatment of angina pectoris was first proposed in 1899 by François Franck. It was first practiced by Jonnesco in 1916. The operation performed by Jonnesco was an elaborate procedure consisting in complete removal of the upper three cervical ganglia and the first dorsal sympathetic ganglion on both sides. Chiefly because of the technical difficulties and in spite of the fact that Jonnesco's first case presented a most satisfactory result the operative treatment of angina pectoris was not popularized. In 1923 Coffey and Brown of San Francisco claimed that their experience with 5 cases showed that removal merely of the superior cervical sympathetic ganglion or even division of the main branch from this ganglion to the heart sufficed to ameliorate the pain in cases of angina pectoris. The successful results reported by these investigators using such a

simple procedure led to a very general practice of surgical operations upon patients suffering with angina pectoris. Whether the procedures mentioned above or the many variations of them, or even the division of those branches from the vagus nerve thought to be the depressor nerve are of value in the treatment of angina pectoris is still under dispute.

In addition to these surgical procedures, there is the method of blocking the white rami at the point of emergence from the bony spine by the use of procaine or alcohol. This method, introduced by Mandl and Swetlow, has been ably defended and popularized by the work of Dr. James C. White, of Boston, and others. Its simplicity, in spite of the danger of the use of alcohol so close to the pleura and spinal cord, commends its trial, and the published figures seem to reveal results comparable to the more serious and cumbersome surgical methods.

The explanation of so many different procedures for the relief of a single condition bespeaks the difficulties which beset this special field. In general we may say that angina simplex, Heberden's angina, is a separate entity, not associated with coronary disease, and not functional. It is probably a disorder of the heart somewhat akin to vasospastic conditions elsewhere. It is probably, therefore, rare, and in studying the case reports one must try to judge comparable entities. Thus, the procedures outlined above could not, of course, be of benefit in coronary closure and it is the inclusion of such cases that makes comparable studies difficult. It is this outlook upon angina pectoris as a vasospastic condition that explains the relief reported by Coffey and Brown when performing removal of the superior cervical ganglion only. In this case they interrupted the motor control of a large enough area of coronary supply to prevent vasospasm. Thus the condition was prevented, not relieved.

But, if a widespread motor involvement is present, we know from the work of Cannon and his co-workers that a much more extensive procedure would be necessary since, even with both stellate ganglia removed, acceleration of the heart beat is possible. This function is lost in the cat when the rami of the upper

nine dorsal nerves have been cut. If one is to look upon relief in these procedures as due to dividing the sensory arc, then an entirely different conception and act is necessary. The work of Ranson and Edgeworth has confirmed the original studies of Langley and Gaskell that the cervical sympathetic system has no sensory fibers above the middle cervical ganglion. It was this conception that prompted excision of the inferior, intermediate, and stellate ganglia. But Danielopolu and others have claimed (though the experimental findings of Cannon and ourselves controvert this) that removal of the main motor control may be dangerous. These views resulted in modification of the original ganglion excision procedures to division of the gray sensory rami only.

Even this brief discussion of the surgical methods proposed for the relief of angina pectoris will convince you of the tangled mass of evidence which confronts the student in this field. Somewhat over 500 cases are presented in the literature. Out of this list not more than 200 cases are worth critical study, and in relation to any single procedure the results are so few as to be unconvincing. It does seem certain that in many cases striking relief has been given sometimes by alcohol injection, and sometimes by the elaborate operation of removal of both complete cervical chains. In my own hands, in but a limited number of cases I have had somewhat better results with the complete cervical sympathetic chain extirpation. But I am not at all convinced that I am competent to inject the rami satisfactorily in all cases any more than I can promise success in relation to root injection in trifacial neuralgia. I believe that the whole problem merits further study, and until more accurate data with careful follow-up studies are available we should withhold any final condemnation or acceptance of one or the other method.

4. Finally we come to the *surgical treatment of mitral stenosis*. The relief of mitral stenosis by surgery is based upon the supposition that mitral insufficiency is more compatible with life than mitral stenosis. The idea is undoubtedly ancient, though it seems to have been first voiced by Samways and

English veterinarian who wrote in 1898 that with the progress of cardiac surgery some of the severest forms of mitral stenosis will be relieved by lightly notching the mitral orifice. A few years later Sir Lauder Brunton urged his surgical colleagues to such an attempt. Sir D. Arcy Power, who is well known to many of you, was then Surgeon to St. Bartholomew's Hospital and he has told me of Brunton's convictions that the thing could be done as well of the negative search by Arbuthnot Lane for a suitable case.

There is no time here to discuss the pros and cons of the assumption that in a patient the reduction of a stenosis would be beneficial. I must leave that to your medical philosophy. But it is fair to state that we had always the greatest fears that even could this be done, the fact that the reduction would necessarily create a very abrupt change rather than the slow adaptation of nature might make such surgical attempts too dangerous.

My own thoughts in this direction date to the winter of 1916-17 when I was a volunteer worker in the Rockefeller Institute. The War interrupted direct efforts, but on our return to civil life Dr. Samuel Levine of Boston and I commenced experimental efforts in the Laboratory of Surgical Research at Harvard. There were many pitfalls and it was more than a year before I began to feel at all sure of our ability to operate within the thorax of animals. Once the difficulties of an open pneumothorax and satisfactory intratracheal anesthesia were surmounted, there presented the difficulties of handling the heart for a deliberate procedure. The rough methods heretofore used of grasping the writhing organ for a rapid manipulation did not appeal to us, since even the temporary anoxemia produced neurological changes such as to forbid its trial in human cases. Gradually a method was developed which allowed us to handle the heart without interfering with its blood supply and so to perform deliberate procedures with satisfactory hemostasis, which method was described in relation to wounds of the heart.

After 2 years of experimental endeavor the opportunity arrived to attempt reduction of the stenosed mitral valve in a girl of 11 years. The trials, tribulations and great mental

anguish of the responsibility as urged at that time are still very bright in my mind. This patient lived 4 1/2 years and was undoubtedly better following the operation. How much of this benefit was due to the surgical enlargement of the orifice, how much to the change of the shape of the thorax, how much to better care and how much to the fact that following the operation she went into slow fibrillation is difficult to judge. Autopsy proved that the orifice had been enlarged.

In this first case a knife was used, modified from a tenotome. Difficulty was experienced in cutting the thickened valve and this experience led us to a protracted study of the physical properties of the mitral stenotic orifice. Out of this study came the cardiovalvulotome—a cylindrical instrument working on the shearing principle which could cut the most calcified valve and would remove the specimen excised.

Since the first case we have carried out this procedure six times. No other case in our series has survived longer than 6 days. Meanwhile other attempts have been made, one by Graham in St. Louis, one by Pribram in Germany and one by Souttar in London. Graham had an operative fatality. Pribram's case lived 6 days and Souttar's case is still living. In our first 3 cases we used the simple knife; in the others the cardiovalvulotome. Pribram used our instrument. Souttar found the mitral orifice large enough to admit his finger; he operated from above and therefore did not carry out any intracardiac procedure.

In our own cases we have experienced chief difficulty in locating the distorted mitral orifice from the ventricular side and though we prefer to approach from below and have full exposure, it may be that the simpler approach via the auricular appendix where the funnel-shaped valve will direct the instrument into the stenosed area will eventually prove the more desirable method. In 2 cases in which considerable segments of the valve were removed we felt that death was due to the fact that the small left ventricle could not handle the greatly increased amount of blood presented to it. In fact this sudden change may be one of the most serious objections to the operation as at present performed.

This is not the occasion to review all the problems presented by this new experience. Some are still under study in our laboratory, for what has thus far been done has not convinced us that the matter is as yet settled. Other cases have presented themselves that justify similar attempts, but until further information is gathered from laboratory data we feel that we should not continue our own attempts. No case, of course, will be a good risk, but when the young person with uncomplicated mitral stenosis reaches that point where life must be restricted to chair or bed, he or she is still in a condition in which this operation can be performed. That is seen in the fact that in our 7 cases only 1 died within 10 hours of the operation. It was the changes brought about by the operation that caused death, not the essential inability of the patient to go through the ordeal. Now that Powers has developed a method for the creation of mitral stenosis experimentally, it may be possible to determine the correctness of this hypothesis. Certainly, it is our hope that further experience will allow us to settle the many problems now awaiting solution.

This is, in brief, the present status of the surgery of the heart. The portals of this last domain have merely been opened. Within its limits are unexplored regions. The present accomplishments are meager in comparison with other fields for surgical endeavor, and there may be those here from whom further developments in enlarging this field will come. It would appear that, even if the therapeutical application of surgery be not extended the advent of surgery into this field has been of much benefit. Certainly it has enlarged our physiological understandings of all that surrounds the function and action of our most vital organ. It has in particular stimulated investigation concerning the extrinsic innervation of the heart and the function of the pericardium. To one who has devoted particular effort to this field, it would appear that investigations concerning the disorders dependent upon a diseased pericardium hold for the moment the greatest promise of

practical therapeutic value. This is so intimately concerned with anything which interferes with the return of blood to the heart that physiologists and surgeons will from now on find their circulatory problems a common one.

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THE OPERATIVE APPROACH TO THE HEART AND PERICARDIUM¹

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IT is just 35 years since Sir Stephen Paget wrote "Surgery of the heart has reached the limit set by nature to all surgery; no new method and no new discovery can overcome the natural difficulties that attend a wound of the heart." In spite of this dictum by a master it was in September of that same year 1896 that Rehn (26) first successfully sutured a wound of the human heart.

The anatomy and physiology of the chest are so unlike that of the abdomen that for a long time men accustomed to abdominal surgery looked askance at the thorax. The bony chest wall is a barrier difficult to pass. The heart and pericardium together with the large vessels at the base of the heart give one pause; the minus pressure in the pleura and the sometimes alarming behavior of the heart and lungs when the pleura is opened are disquieting factors; the disastrous results following on postoperative drainage of the freshly opened thorax are hard to forget while the difficulty experienced in making a correct anatomical location of chest pathology has harassed the careful surgeon. All of these factors together with some others have slowed up the development of chest surgery. Certainly an exploratory thoracotomy is hardly permissible except under unusual circumstances and there is scarcely any operation so futile and damaging as hunting around in the thorax for pathology that had not been accurately located before operation.

In this paper we are concerned only with the operative approach to the heart and pericardium. Roughly the different methods by which these structures may be reached by the surgeon fall into four groups as follows: some one of the left lateral or parasternal routes which are usually ample in wounds of the left side of the heart; arrest of the heart and thrombosis of the pulmonary artery; the approach through the triangle of safety in draining an infected pericardium; central sternotomy in the surgical treatment of valvular

disease; foreign bodies in the chambers of the heart or imbedded in the wall of the heart and removal of considerable areas of the precordial bony chest wall for chronic pericarditis and cardiac hypertrophy.

Let us consider first the approach to the heart and pericardium when either or both of these structures are injured. Here tamponade of the heart by blood in the pericardial sac is the condition calling most urgently for relief. If there is a wide opening in the pericardium and a wound of the heart opening into one of its chambers, death from loss of blood will usually occur before the patient reaches a hospital. If the patient is still alive when seen it is not the loss of blood itself that is doing the damage but pressure upon the heart by the blood trapped in the pericardial sac. The diagnosis of injured heart or pericardium is made from the location of the wound and the symptoms of heart tamponade.

Many of these wounds enter the chest to the left of the sternum. If this type of wound is present the choice of operation is simple because in left-sided wounds of the chest it is the left side of the heart that is apt to be injured and the left side of the heart is exposed quickly by one of the left parasternal approaches. There are a number of these. Until recently the Kocher (4) method was one of the best known and most used; that is by turning out a lateral flap composed of the entire thickness of the chest wall and including the third, fourth, fifth and sixth cartilages. Burghard (5) modified this by raising the flap in two layers.

The Wilm's (5) operation is a long intercostal thoracotomy between the fourth and fifth ribs with the use of a rib retractor. This is a very excellent approach in surgery of the lung but it does not give a very good exposure of the heart. Lilienthal uses a long intercostal incision in the seventh interspace and widens the exposure with a rib retractor.

In addition to the flap and intercostal method there is a third parasternal approach

which has been much used. Here exposure is gotten by the removal of varying lengths of one or more ribs.

While these methods have been repeatedly used by the masters of surgery, the Spangaro approach seems the simplest, gives a good exposure, is quickly and easily made, and renders air-tight closure easy of accomplishment. While all of the features of this operation as now performed were not originally practiced by Spangaro, most of us agree with Cutler that Spangaro should be given credit for originating this method of reaching the heart.

The incision extends in the fourth interspace from the anterior axillary line to the margin of the sternum, where the sternal attachments of the third, fourth, fifth, and sixth cartilages are exposed and as many of them separated from the sternum as is necessary to give a good exposure. The exposure is much improved by a rib retractor and the one described by Lilienthal is best known to me. While the Spangaro operation is described as an intercostal approach in the fourth interspace, any interspace may be used that gives the best access to the site of that particular injury.

During the last 2 years 3 patients have been operated on for penetrating wound of the heart or pericardium in the University Hospital in Baltimore. Two of these were operated on by the resident surgeon at the time and one by myself. One was a penetrating wound of the left ventricle operated on by the resident (29). The left pleura was injured also. This patient died on the third day. An autopsy was permitted and death was found to be due to pneumonia of the left lung. There was little fluid in the pericardium and the wound in the heart was in good condition.

The second patient was operated on by myself. He was a young negro man who was brought into the accident room a few minutes before I was to operate on another patient before a group of students. The wound of entrance was in the third interspace just to the left of the sternum and was caused by a knife. The man was unconscious and pulseless at the wrist, but was breathing quite well. Listening over the heart disclosed weak and irregular movements but no regular and sustained

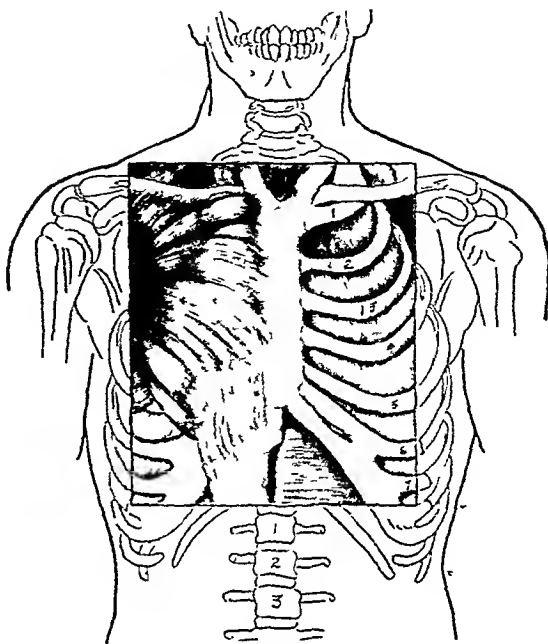
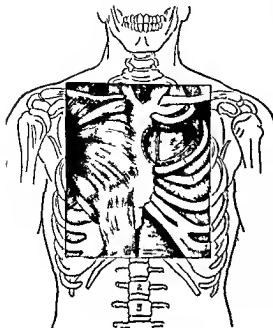


Fig 1 Relationship of muscles, sternum, ribs, and cartilages in the average thorax

pulsations were made out. He was brought directly into the operating room and hurriedly prepared. The operating room was already set up and the assistants were ready. The first part of the operation was done without an anesthetic. An intercostal incision was made in the third interspace, the skin incision running also obliquely across the left half of the sternum. The cartilages of the third and fourth ribs were separated from the sternum, and the Lilienthal rib retractor was inserted. The internal mammary vessels were tied. The left pleura had been opened by the thrust of the knife and contained considerable blood and the left lung was partially collapsed. There was an opening in the pericardium high up on the left and at the level of the left auricle. The left margin of the sternum was in the way and a half-moon section of it was gouged away with large rongeur forceps. This combination approach gave a good exposure of the opening in the pericardium, which was distended and filled with blood. During this time there was little change in the patient's condition. He seemed in the act of dying, but continued to live. The opening in the pericardium was enlarged and several ounces of bright red blood escaped. There was no rapid gushing of blood, but a steady welling-up. Because of the nature of the bleeding, the left auricle was examined first and a small hole was found in the auricular appendage. This part of the auricular appendage was grasped with a curved clamp and held very gently while a silk ligature



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When one comes to close the wound the great advantage of the intercostal approach over resection of one or more ribs is at once apparent. It is not necessary to close the pleura by a separate suture. This is difficult in any case as the pleura is very thin and tears and cuts through when sutured. The displaced ribs are pushed back into position and held there by throwing heavy interrupted catgut sutures around them and tying these sutures tightly enough to hold the two ribs immobile in their relation to one another so that they move in unison with respiration. Because the distance between the ribs is

somewhat lessened by the sutures the cut edges of the pleura are in contact and soon unite. The muscle subcutaneous tissues and skin are closed in separate layers.

The third patient in this group was operated on by the resident surgeon for stab wound in the third intercostal space. The Spangaro approach was used and the internal mammary vessels found severed. They were heated. There was a wound in the pleura and a small wound in the left side of the pericardium. Most of the bleeding came from the severed internal mammary vessel because after these vessels were ligated and the blood sucked out of the pericardium and pleura there was no further bleeding. Both the pericardium and pleura were closed and an air tight closure made of the chest wall. His recovery was uneventful.

The left parasternal approach is also used in operating for embolism of the pulmonary artery. Trendelenburg made an incision over the second rib 12 centimeters long and an other incision parallel to the left edge of the sternum from the first to the third rib. He turned up two soft parts flaps and removed the second rib throughout the length of the incision and a shorter section of the third rib. He then ligated the internal mammary vessel and opened the left pleura which was followed by collapse of the lung. He then opened the pericardium high up being careful to stay in front of the phrenic nerve. This brings the pulmonary artery and aorta directly into view with the pulmonary artery to the left of the aorta. Trendelenburg and his associates operated on 12 patients by this route without a recovery. Kirschner Meyer Stegmann Crafoord Nystrom Lake De Harven all operated for pulmonary embolism by this approach. A number were careful not to open the pleura. Very gentle handling of the pleura in all operations in this neighborhood is essential. If it is already opened or has to be incised for any reason it should be protected and packed off by soft moist dressings. Carrel has laid especial emphasis on this precaution.

I have not operated for thrombosis of the pulmonary artery but I believe the Spangaro approach would more quickly expose

this artery Lockwood, however, speaking of the Trendelenburg method, says "I have carried out the procedure repeatedly at autopsy It is not at all a difficult feat"

Every operating room staff should be prepared to deal with arrest of the heart This accident occurs frequently enough during the course of some operation or manipulation In most instances after a short and very anxious interval, the heart begins to pulsate and in a short time goes on as if nothing had happened This fortunate outcome may be helped along by sharp slapping of the chest, lowering of the head of the patient, and pulling forward of the tongue Forceful pressure upon the precordial area with short and snappy release of pressure may aid in forcing some blood into the heart

If, after a short interval, the heart is still not beating, cardiac massage offers the best chance of recovery If either the abdomen or chest is open at the time, this maneuver is easy The diaphragm is usually relaxed and it is not difficult to compress the heart between the hand invaginating the left diaphragm and the anterior chest wall

We have had considerable experience with the treatment of heart arrest using these measures Recently, while freeing a large tumor of the kidney by the transperitoneal route, pulsation in the aorta suddenly ceased On palpating the heart, it was still After compressing and releasing the heart between the hand and the chest wall by invaginating the diaphragm a number of times, there was a faint movement of the heart and some irregular beating and after a few minutes the pulse at the wrist returned

If neither the chest nor abdomen is open at the moment of heart arrest, one has to decide quickly on the method of approach to the heart The choice is between laparotomy and thoracotomy The easier and quicker method is through an upper midline abdominal incision If, for any reason, this approach is not feasible, then the chest should be opened by an intercostal incision, either the Spangaro operation or the Wilm's approach being used, as the heart can be exposed more quickly by either of these routes than by turning out a flap or by resecting ribs The

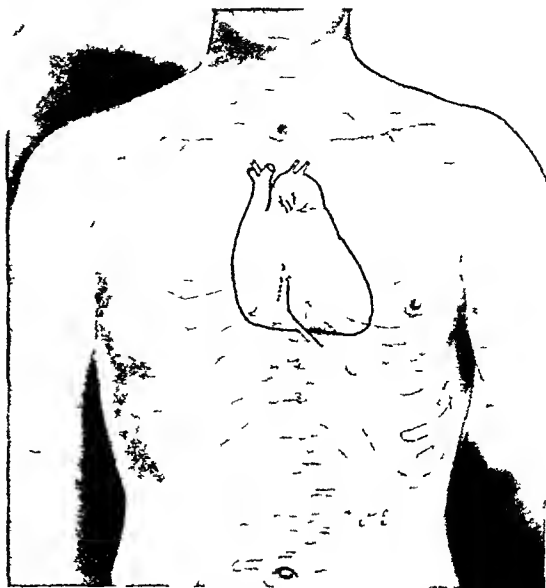


Fig 3 Skin incision in the combined transsternal and transchondral approach in performing pericardiotomy for pyopericardium

median approach through the sternum takes too much time About 6 minutes is the usual limit, if consciousness is to return after the heart resumes its pulsations

Pericardiotomy for suppurative pericarditis is worthy of careful consideration Pyopericardium is much more prevalent than the reports would indicate

There are four chief avenues of approach All are based upon the "triangle of safety" of Voimtsch-Sionojentsky, which is a small triangular area uncovered by pleura situated in front of the pericardium It begins at about the level of the anterior ends of the fourth ribs and extends downward to the diaphragm which in the midline, is about behind the junction of the second portion of the sternum with the ensiform This triangle has its apex up and base down and is just a little to the left of the midline Its size will depend upon the size of the patient and the amount of bulging forward of the enlarged heart or distended pericardium

Just to what extent the symptoms are due to heart tamponade and just how much to infection is sometimes difficult to estimate There are three chief factors, tamponade of

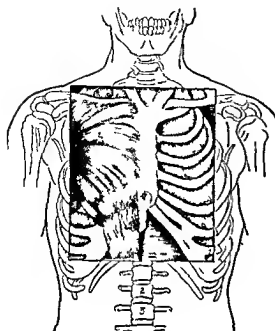


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the heart infection of the pericardial chamber and infection of other structures. Pyo pericardium is apt to complicate an infection elsewhere such as pneumonia empyema or osteomyelitis. If there is any considerable amount of pus within the pericardial sac tamponade will be evident and the pericardium will be found enlarged by physical examination and roentgenogram.

Most of the fatal cases are either neglected cases of purulent effusion or are those cases complicated by serious infection elsewhere in the body. The last patient on whom I operated was a man who had been ill 4 weeks and who had a localized left sided empyema and purulent pericarditis and did not recover. The last case that I saw was a child 6 months old whom I saw for the first time just after it had died of a large purulent pericarditis in which the diagnosis had been made by looking at the X ray plate a few minutes before. Aspiration of the pericardium after death confirmed the X ray diagnosis.

Altogether I have seen 12 patients with suppurative pericarditis and have operated

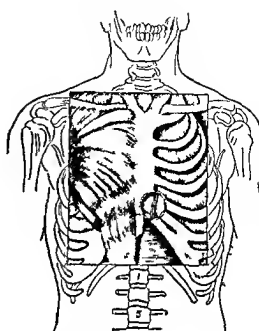


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on 12 of them with 6 recoveries and 5 deaths.

In 4 patients the transsternal route was used. This is a very simple and easy way to reach the pericardium provided a number of factors are borne in mind. It is especially useful in operating on small children because the finger of the surgeon may be carried around the heart in order not to overlook pocketing of pus by fresh adhesions within the pericardium.

This approach was advised by Riolanus in 1648 and in 1818 Skielderup repeated the suggestion. It was put in practice by Malle in 1855 who emptied a pericardial sac of blood by this method. Up to 1927 Dr Nathan Winslow and myself could find only one pyopericardium drained in this way that of Bexman who operated in 1891 with recovery of his patient.

In adults it is difficult to explore the pericardial sac with the finger inserted through a small trephine opening in the sternum so that in 5 of these patients the chondro-epiphoid approach was used. This approach was described by Larrey in 1829. An incision

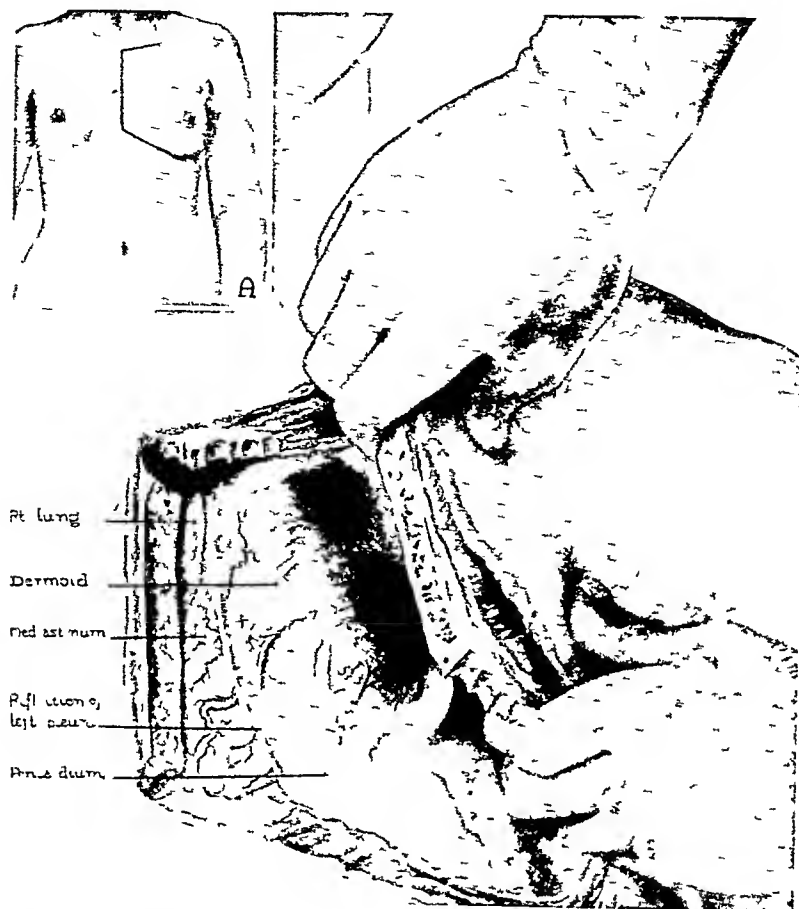


Fig 6 A new method of thoracotomy with beveled incision of sternum and intercostal incision through the first and sixth interspaces (From Kerr and Warfield, *Ann Surg*, 1928, LXXVIII, 620)

is made over the seventh cartilage from its junction with the sternum downward and outward. The cartilages of the seventh, sixth, and sometimes the fifth ribs are cut away with a knife and rongeur, the knife being made to hug close to the sternum. In 2 patients a curved piece of the sternum was bitten away with rongeurs. This exposure brings into view the left margin of the pleura and the internal mammary vessels. Both may be pushed to the left, and the pericardium opened near the diaphragm. This approach allows ample space to palpate the inside of the pericardium.

In the 2 last patients, I have used a combination of both of these methods, which is

more satisfactory than either, as it is quickly and easily made and has the advantages of both and the disadvantages of neither. The sternum is trephined just above the junction of the gladiolus with the ensiform and a little to the left of the center. This burr opening is then enlarged with rongeur forceps to the left until the lateral segment of the sternum and the ends of the fifth and sixth cartilages are cut away. This exposes the uncovered portion of the pericardium and the left margin of the pleura, and the internal mammary vessels hardly enter the field. It has the great advantage of bringing one down directly on the "triangle of safety" through a bloodless field and then enlarging the field as

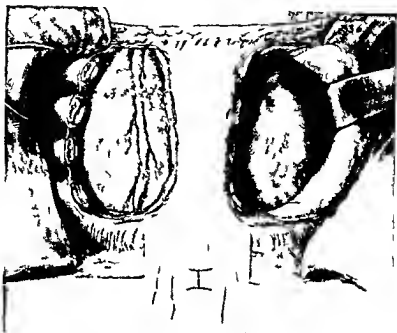


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much as is necessary to allow incision examination and drainage of the pericardium.

The pericardium can also be drained by a left or right parasternal approach. Either of these methods is satisfactory if the pericardial effusion is quite large otherwise there is considerable risk of opening the pleura.

By whatever route the uncovered pericardium is reached the next step is an anxious one. In my experience no matter how much or how little fluid was afterwards found in the pericardium the anterior surface of the left ventricle near its tip was always felt tapping against the taut pericardium at each systole of the heart. In my first case I would not have opened the pericardium if the internal tube had not been present with pus in a test tube that he had gotten by paracentesis of the pericardium. One does not know how thick the pericardium is nor can one be certain that there are no adhesions between the heart and pericardium so that cutting through the pericardium toward the tapping heart creates a feeling of anxiety and uncertainty. In order

to make this step safer and easier I now grasp the pericardium with two Halstead forceps plicating some of the pericardial sac and then palpate and incise the plicated pericardium between these forceps very much as some surgeons open the pleura or peritoneum.

When the pericardium is opened there is a gush of fluid sometimes frank pus sometimes thin purulent cloudy or blood tinged fluid. In only one of my patients were any adhesions found and this patient later developed a walling-off of pus lateral to the left auricle which necessitated a second operation.

As soon as the pericardium is opened a very important factor immediately enters into the problem. In a report read before the American Association for Thoracic Surgery in 1928 by Dr Horne and myself (30) we made the following observation. Because the pressure everywhere within the thorax except in the lung itself is lower than that of the atmosphere one's curiosity is raised as to the effect of atmospheric pressure on the heart after pericardiotomy. Certainly the func-

tion of the wall of the chest is to maintain a negative pressure within the thorax, and it is not unreasonable to suspect that the heart may be disturbed by exposure to atmospheric pressure. We believe that closed drainage of the pericardium in purulent pericarditis might lessen some of the imperfect results that follow on drainage."

In the *Archives of Surgery* for November, 1930, Beck and Cox (3) published the results of their experiments on the mechanics of the circulation following pericardiostomy. Their findings were definite: showed rise in venous pressure, fall in arterial pressure, decrease in minute volume output of the heart.

This work brings sharply to the attention of the medical profession again the old question that has been so much discussed, to wit: whether or not it is wise to subject intrathoracic organs to the pressure of the atmosphere while exposing them for operation.

Surgery of the valves of the heart, foreign bodies in the chambers of the heart, foreign bodies embedded in the heart muscles or any surgery involving either of the venæ cavæ, together with wounds of the right side or posterior surface of the heart, require good exposure and ample space in which to manipulate the heart.

The heart will tolerate considerable handling and may be elevated from its bed, the vessels at the base may be intermittently compressed, but it is hardly possible to rotate the heart to any extent, and for this reason it is almost impossible to bring the right side or posterior wall of the heart within reach of any sort of left-sided approach unless a considerable portion of the sternum is removed.

The approach that meets these conditions best is the median sternotomy, known as the Duval-Barastý median thoraco-abdominal pericardiostomy. This approach was used by Cutler in his epoch-making work on mitral stenosis. Matas reported three operations done by French surgeons for the removal of foreign bodies by this access to the heart. I have had no experience with it on the living patient, but in the dead house it gives a wonderful access to the heart and pericardium without injury to any large vessels and without opening either pleura.

It is a time-consuming procedure, however, both in entering the chest and in closing the wound. It opens two cavities: the abdominal and the thoracic, and in patients already handicapped by some serious heart ailment requiring operation, the time factor is important. It has two great advantages over any other approach in that it allows easy access to the posterior surface of the heart and does not open either pleura.

Kerr and Warfield in the *Annals of Surgery* for 1928 described a central lateral flap made up of one-half of the sternum and a portion of the chest wall. They used this approach in removing a dermoid of the mediastinum. It has the advantage of not opening the abdomen and it makes possible an easy airtight closure.

There is another group of heart and pericardial affections that is now attracting very considerable attention. The main consideration in this group is crippling of the heart because of adhesions in which the pericardium plays the major rôle.

Obviously, the pericardium may be firmly adherent to surrounding structures without much affecting the heart, unless there are adhesions fastening the heart to the pericardium. Many of the acquired displacements of the heart are due to this cause. In nearly every patient with unilateral fibroid phthisis, the heart is more or less displaced toward the diseased side because of these adhesions.

If the heart is adherent to the pericardium and the pericardium is not constricted or adherent to surrounding structures, it gets along very well in the majority of instances.

Of the 6 patients on whom I have operated for pyopericardium and who recovered, I have kept track of 5 and no one of the 5 is disabled. Several had a slow recovery and one boy had anasarca and ascites with shortness of breath for several months, but now, after 5 years, is apparently well.

If the heart is adherent to the pericardium, which in turn is fastened to the unyielding chest wall, a condition of affairs may be created which led to the suggestion of Brauer that the bony chest wall be removed over the precordium so that the pericardium could follow the contracting heart during systole.

In 1928 Smith and Liggett reported 107 such operations collected from the literature. A number have been added since.

This operation has been given a number of names but is usually spoken of as the cardiomyolysis of Brauer. It is a relatively simple procedure in which enough of the bony chest wall in the precordial area is removed in order to free the adherent pericardium. This same operative approach is used in decompression of the heart for hypertrophy where pericarditis plays no part. Monson proposed this in 1907 and Mr. E. C. Stabb operated on a youth 19 years of age. Evarts Graham discussed this operation in 1928 and in November 1929 reported the cases of 2 children on whom he had decompressed the heart because of hypertrophy.

Recently I used this same method of thoracic decompression in attempting to relieve the pressure symptoms in expanding aneurism in the upper thorax. In one instance the result was very striking. The patient was a negro man 32 years old with aneurism of the innominate artery. He was in great distress because of pressure within his thorax. He could not lie down and had great difficulty in breathing in any position. I saw him with Dr. Thomas R. Boegs at the City Hospitals, Baltimore.

The cartilages and the sternal ends of the right second, third and fourth ribs to either with a portion of the right side of the sternum were removed. The technique somewhat resembled that of a high anterior extrapleural thoracoplasty. The relief of the patient was very marked. He left the hospital in a short time much improved and quite comfortable. He died several months later following wiring of the aneurismal sac which was done in another clinic.

If the chronic pericarditis is a constricting one then a very serious condition is present known as the Pick syndrome. It is difficult in many instances to know whether the chronic pericarditis is a constricting one or not. If the cardiac disability is due to constriction of the heart then the simpler Brauer procedure will not suffice and the operation suggested by Delorme is indicated. Here it is essential that the pericardium and heart

be well exposed in order that pericardiectomy can be carried out. Weil suggested the operation in 1895. Delorme urged it in 1898 and it was again referred to by Carl Beck in 1901 but it was not until 1913 that Rehn (27) reported his first case.

In 1929 Churchill reported a collection of 37 patients on whom pericardiectomy had been done. Nineteen did well, there were 7 operative deaths, 2 were not improved and 4 died later. In 5 patients the operation was not completed. Volhard and Schmieden have reported the largest number, 7, which are included in Churchill's list.

There are three problems and all are important: the diagnosis, the exposure and the removal of the constricting pericardium. It is with the exposure that we are concerned in this paper.

If the heart is to be freed a left-sided parasternal approach is hardly ample. The Duval-Barastay combined thoraco-abdominal operation adds considerably to the shock.

Beck (2) in an excellent paper read before the Section on Surgery of the American Medical Association in June of 1931 discussed this subject reported on the Pick syndrome from the experimental standpoint and reported a recovery after pericardiectomy. The exposure was made by resecting the left third, fourth, fifth and sixth costal cartilages and part of the sternum. He suggested a new approach to the pericardium and heart for pericardiectomy by a bilateral exposure gotten by resecting a part of the sternum and the cartilages of the third, fourth, fifth and sixth ribs on both sides, thus bringing into view the entire heart. I have a letter from him dated September 19, 1931, in which he reports having operated successfully on a patient by this approach and that he knows of a patient operated on by another surgeon who got a satisfactory exposure by using this route in suturing a wound of the heart.

Evidence is accumulating that makes it incumbent upon us to distinguish clearly between the different phases of chronic pericarditis. There are four of these adhesions between the pericardium and pleura adhesions between the pericardium and heart—these two rarely call for surgery; adhesions be-

tween the heart, pericardium, and chest wall, which, if disabling, call for the Brauer operation, and constricting pericarditis, for which disabling disease pericardiectomy is indicated. Evidence is also accumulating that in the last condition surgical intervention should be considered seriously and operation, if it is to be helpful, requires ample exposure and careful freeing of the entire heart.

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SOME OLD TRUTHS ABOUT FRACTURES¹

WILLIAM DARRACH MD ScD LLd FACS NwY

THE object of the Clinical Congress of the American College of Surgeons is to increase the knowledge of the members of the College by intimate contact and the exchange of ideas. During your sojourn in New York you are being shown and told many new ways and means of surgical treatment new method of diagnosis new theories as to the causation of surgical conditions. I am sure that much of it will prove helpful to you in your thinking and in your practice. I trust that much of it will prove to be true.

Let me confess to you now lest your disappointment be too great later on that I have nothing new to offer you hence the title I have selected. Some Old Truths About Fractures. My excuse for daring to come before you with such a paltry and time worn offering is that only too often the results of fracture treatment that we see among our own patients as well as those of our colleagues can be explained only by supposing that some of these old truths have either been forgotten or neglected. Our bad results are due more to neglect procrastination and carelessness than to ignorance. I therefore feel justified in discussing with you some of these old truths.

In fractures the injury is not limited to bone. When due to direct violence there is contusion of the overlying parts. The ligaments and other supporting tissues of the adjacent joints are strained if not actually torn. The excessive muscular effort made in resisting the traumatizing force may injure tissue. When the force is sufficient to cause displacement of fragments the sharp edges of the broken bone ends tear periosteum overlying muscles tendon sheaths blood vessels and nerves. There is local hemorrhage from broken bone and from lacerated soft parts. In fractures the injury is not limited to bone.

Proper first aid treatment should be taught in medical schools but of still greater importance is the education of the public. Most of the additional and quite unnecessary trauma occurs before the patient reaches medical aid.

The surgeon may disclaim responsibility but it is his duty to try to teach the public. The value of early splintage was well proved by the British Medical Service when they sent the Thomas splint out with the stretcher bearers.

The injuries resulting from fractures are not limited to those occurring at the time of the accident. Unwise attempts to use the injured extremity may cause or increase displacement of fragments increase the laceration of soft parts and perhaps lead to penetration of the skin by ends of bone. The same additional trauma is often due to the awkward efforts of the bystander. A man is struck by an automobile thus breaking his leg. Except for the broken bone without displacement the original injury may be merely slight perosteal tear and mild contusion of soft parts but he is helped to his feet and the leg gives way the fragments slide by each other thus stripping off the periosteum and tearing the muscles. He falls to the ground only to be picked up and carried to the sidewalk ledge dangling. Larger blood vessels are torn the bone end comes through the fascia perhaps the skin even the trouser. He is laid at rest with a coat beneath his head and surrounded by people anxious to help. Someone sees his leg is crooked and straightens it out. The exposed bone end re-enters the wound with a bit of trouser and the dirt of the street. Again he is lifted up and carried to a car or ambulance. This time someone carries the injured leg with better intention than coordination and the ends of the bone are churned around in their bed of lacerated tissues and the contaminating organisms well disseminated throughout the area. Dunn his ride and in the transfer to the accident ward or the doctor's office unless he has been carefully splinted there is more jolting and more damage. Would that his troubles were over but too often the sad story continues. Lack of sufficient protection as he is lifted to and from the X-ray table and as he is being

anæsthetized, examinations which are too rough or extensive, or repeated, result in still more injury

Compare this exaggerated picture with a similarly injured man who is allowed to remain where he is until a proper splint can be applied, or at least can have someone pull hard on his foot as he is being lifted and carried, whose examination is thoroughly but gently carried out, and whose treatment is instituted with but little additional injury. The difference in these 2 cases as regards time of disability and amount of permanent functional disturbance is tremendous

Fractures are not always single Although it was 20 years ago, I remember distinctly my sensations when I realized that a certain patient, who was recovering from a fractured skull, also had a dislocated elbow. Three weeks was too long a time to elapse before making a diagnosis. People often have multiple injuries. I blush to think of another instance when a man who had broken the shaft of his humerus told me 3 weeks later that he couldn't lift his wrist. My records did not show anything about this detail either before or after reduction and I wondered whether the nerve was hurt when he broke his arm, or whether it happened during my reduction, or whether it was involved later on in the callus formation. *Nerve injuries are sometimes associated with fractures*

If we could only remember to investigate these matters! But having found what we consider the main lesion, our relief and satisfied curiosity only too often let us stop in our search for facts. Careless or hurried examinations lead us into trouble. And yet, the rough examination, the search for false point of motion and crepitus is, as we have said, accompanied by added injury and a greater problem of repair. The examination should be thorough enough to bring to light the necessary information but gentle enough to cause the least amount of additional injury.

Local reactions to injury begin immediately In addition to the extravasation of blood into the tissues adjacent to the site of fracture, we find œdema developing within the hour. This adds to the swelling and impedes the circulation. The infiltrated muscular tissue short-

ens and its elasticity decreases, making reduction of displacements more and more difficult. Soon the blood clots and a fibrin network is formed to act as trellis for the new forming connective cells and new blood vessels. The rapidity with which the process of repair gets under way was not understood by that surgeon who is responsible for the old advice "wait 'till the swelling goes down" nor by those many authors and teachers who have handed it on down through the generations. This adage should be replaced by another

Every fracture should be considered an emergency condition A broken bone deserves as much consideration of the time element as a ruptured ulcer or an acute appendicitis. Every hour that goes by makes existing displacements more difficult to overcome. The recognition of the need for the early reduction of existing displacements has greatly reduced the time of disability and degree of permanent impairment of function.

The treatment of fractures should be based on a detailed consideration of the anatomy and pathology of each individual case We are too prone to follow blindly set rules of procedure. We are too apt to say that a Colles fracture should be reduced by such and such manipulations. A certain form of splint should be applied. After so many days it is removed and the patient urged to resume use of his injured extremity. After a thorough examination and a careful study of the X-ray evidence, it should be possible to determine just what procedures are required to restore the fragments to their normal relationship, with the least additional injury. We should also decide by what method this reduction can best be maintained. The plan of campaign should be arranged to solve the problem of that particular case. These plans should include not only the method of reduction but also the method by which the bone fragments are to be maintained in their new position. Don't start the anæsthetic until all necessary preparations have been made and material assembled.

Reduction of displacements should be as gentle as possible Displacement of fragments is due to the traumatizing force plus the pull

of contracting muscles. To obtain a gentle reduction an anæsthetic is required to relax the muscles and force must be applied to restore normal relations. Unless this force is applied thoughtfully and carefully, unnecessary additional injury will result. Fragments often have to be disengaged which may require an increase of the existing deformity. The basic element is usually traction in the axis of the extremity. This often must be aided or followed by lateral pressure to make the fragments engage but lateral pressure applied before the fragments have been disengaged causes unnecessary injury to the bone ends. The results of our attempts must be checked immediately first by clinical examination and then by X ray.

The treatment of fractures subsequent to reduction is a double problem. The injured bone must be protected during the healing process lest the displacement recur. This means rest, relief from strain, immobilization. The injured soft parts must be restored to their normal state as quickly as possible. This means early functional activity and the various forms of physiotherapy. Above all, the circulation of the affected region must be maintained at its greatest efficiency. Methods aimed to protect the bone, delay the soft part recovery and interfere with circulation. Procedures directed toward the latter endanger the bone. The art of treating fractures lies in the adjustment of these opposing indications and in deciding how far we may safely risk one to benefit the other. Only the most general rules can be laid down. The details must be developed to meet individual conditions at each stage of repair.

Traction is most useful in the treatment of fractures. It is the basic principle in reducing displacements. It is also widely applicable in maintaining reduction. But some of the old principles are not understood or forgotten. Continuous traction remains effective only when sufficient countertraction is provided for. Many beautiful banjo splints are applied but the elastic pull is relaxed within 24 hours. In many Balkan frames the patient slides down until the pull is relieved. The adoption of continuous traction as a means of reduction does not disbar other methods.

If the overriding of a fractured femur is not overcome by traction within 24 to 48 hours it is better to try manipulation than to go on hoping in vain. Soon the callus formation will prevent reduction by any except open method. The amount of traction should be varied with its object. It takes 30 pounds to accomplish a reduction which can then be maintained by 10 pounds. The indication for traction in maintaining reduction is more frequent and more lasting in oblique fractures than in those which are transverse.

The dangers and difficulties of the open method of treatment are greater than those of the closed method. It should be adopted soberly, advisedly and wisely and only by those who are willing and able to develop and carry out the special technique involved. It is indicated only when the result which can be justifiably expected will be sufficiently better than that to be obtained by other methods as to warrant the added risk.

The present situation of compensation machinery needs radical change. While it undoubtedly brings financial relief to many injured people who otherwise would be in dire straits it also prolongs the period of disability for many far beyond what it should and could be. The condition called compensation is often worse than the original injury. It is foolish to expect an individual's disability to stop until his compensation for that disability has been settled.

The general public is overoptimistic about the results of fractures. Their attitude toward the surgeon is much the same as it is toward the obstetrician. If things go well—why of course. But if the result is not perfect—it was the doctor's fault. They do not seem to realize that the original injury may have been too great for a good result. This attitude of mind seems to be especially prevalent among those who make up juries in damage suits. Let us hope that the American College of Surgeons can spread among the public not only gentleness in first aid treatment but broadmindedness in judging our results.

Success depends on intelligent co-operation. In few other fields of surgery is the partnership between surgeon and patient of more importance than in fractures. The surgeon

can do a good deal to help him get well but the result depends even more on the patient's bodily processes of repair and his voluntary acts of co-operation. We cannot do much to aid his process of repair but we can refrain from doing a great deal of harm. We can avoid much unnecessary additional trauma, interference with circulation, too long immobilization and other details. By patient explanation and drilling we can encourage him to carry on—not extensive movements

three times a week, but gentle action every hour and in other ways to do his share of getting back to the nearest approach to normal and at the earliest moment circumstances permit. At the same time we can spare him undue disappointment and ourselves censure by trying to predict the probable outcome. Let us remember the old advice of William T. Bull, to his assistants: "Doctor, if you can't help, for God's sake don't hinder!"

DENERVATION OF THE ADRENAL GLANDS FOR NEUROCIRCULATORY ASTHENIA

TECHNIQUE AND CLINICAL RESULTS¹

GEORGE CRILE M.D. FACS C. E. AND D. O.

CL. 14 Clin.

BASED on favorable results of experimental investigations of the adrenal sympathetic system and on conclusions drawn from operations on the thyroid sympathetic system in cases of hyperthyroidism we have sought to control certain analogous energy transforming diseases particularly those due to pathological activity of the adrenal sympathetic system. To this end we have performed operations on the adrenal sympathetic system in 126 cases. On this occasion however we shall report the results obtained in one group only namely cases of neurocirculatory asthenia.

In the war a certain number of officers and men became incapacitated during their service at the Front on account of a baffling disorder which was designated soldier's heart the principal features being rapid heart beat nervousness and fatigue. In the stress of civilian life there are seen many cases of this same condition which is usually given the descriptive name neurocirculatory asthenia. This disease resembles and is often mistaken for mild hyperthyroidism especially in those cases in which there is a goiter and a moderate increase in the basal rate.

Neurocirculatory asthenia is a pathological state in which there is an excessive stimulation of the adrenal sympathetic system and since other kinds of treatment have failed uniformly we logically concluded that since hyperactivity of the thyroid—hyperthyroidism—could be reduced then hyperactivity of the adrenals could likewise be reduced.

In association with Dr. E. P. McCullagh a critical study has been made of the effects of certain operations on the adrenal gland and sympathetic nerves the basis for these operations being as stated the conception that neurocirculatory asthenia is an example of pathological physiology analogous to the conception that hyperthyroidism is an example

of pathological physiology. Jonnesco many years ago resected the cervical sympathetic ganglia for hyperthyroidism—an outstanding example of an attempt to modify pathological physiology. So too an adrenalectomy performed by me 19 years ago was an attempt to modify certain cases manifesting symptoms of pathological physiology by surgery. Lenche of France Hunter and Royle of Australia Adson Craig and Learmonth and others are advancing this field of the surgical control of pathological physiology.

About 19 years ago I first tested the effect of the removal of one adrenal gland in certain cases which manifested symptoms of pathological physiology in some cases supplementing adrenalectomy by thyroidectomy and resection of the cervical sympathetic ganglia. The results gave promise but in some cases the good effects tended to disappear in time just as after unilateral thyroidectomy for hyperthyroidism the clinical results are good at first then tend to disappear.

After following these patients for a period of years and undertaking new lines of investigation it was found that a more effective procedure was bilateral denervation of the adrenal glands the two denervations being separated by an interval of a week or more.

Since we consider that the adrenal gland constitute the power stations or brain of the sympathetic system and that in neurocirculatory asthenia the power station is pathologically stimulated just as the sympathetic ganglia are too active in Raynaud's disease we tested this conception by severing the nerves emerging from the adrenal gland.

Our first task was clearly to differentiate neurocirculatory asthenia from a group of diseases which present many symptoms in common. We clearly excluded the diseases analogous to neurocirculatory asthenia the mechanism of which involves changes in the

action patterns in the brain. Among these excluded diseases are psychoneuroses, psychoses, neuroses, hysteria, maladjustments, in short all mental and psychic diseases. We thus limited our attack to that pathologically excessive activity of the adrenal-sympathetic system which produces a classical picture of abnormal nervous excitation, abnormal palpitation of the heart, abnormal nervous fatigue. The analogy to hyperthyroidism is at once apparent, since either the division of the sympathetic nerve supply to the thyroid, or of the adrenal nerves, profoundly modifies the hyperplasia of the thyroid gland, the metabolic rate, and all the symptoms of hyperthyroidism, while on the other hand, abnormal stimulation of the adrenal-sympathetic system easily reactivates the thyroid. That is to say, any one of the several links of the kinetic system may become the site of pathological physiology. This is especially true of the brain itself.

Theoretically, it is clear that pathological physiology of the brain can not be relieved by denervation of the adrenal nerves. We have tested this most important clinical point and have found that after adrenal denervation psycho-asthenia, psychoses, psychoneuroses, oddities of action patterns, and hysteria are not in the least benefited, just as these psychic and mental states are not benefited by thyroidectomy, by ganglionectomy, etc.

The theoretical and the practical indication for denervation of the adrenal glands is found in those individuals whose mental and psychic mechanism falls within normal range, but whose sympathetic system is under an otherwise uncontrollable stimulation analogous to that present in hyperthyroidism and in Raynaud's disease.

ANATOMY

The technique of adrenal denervation requires a precise knowledge of the anatomy of the adrenal glands especially in relation to their nerve and blood supply, and to their position with relation to other organs (Fig. 1).

The adrenal gland is a diminutive yellow pancake, golden in color, soft, friable, and vascular. As indicated by its name, it is situated adjacent to the upper posterolateral aspect of the kidney and always close to the

vertebral column. An arrow piercing both adrenal glands would pass approximately through the center of gravity of the body. The gland is held in place by the strands of the sympathetic web, by the slender fibers from the neighboring fascial planes, and by its blood vessels. It is completely embedded in fat, and, on palpation, the adrenal border gives an impression unlike that of any other organ except the external ear to which it is similar in contour and motility.

The right adrenal gland lies in proximity to the diaphragm, the vena cava, the liver, the head of the pancreas, the duodenum, the kidney and the vertebral column. The left adrenal gland lies in proximity to the tail of the pancreas, the spleen, the aorta, the diaphragm, and the spinal column.

When the fascial sheet which binds the kidney to its halo of fat is opened, long blood vessels may be seen passing downward at the side of the kidney toward the vertebral column. These vessels are arrows which mark the trail to the adrenal gland. Generally there is an artery at the outer border of the adrenal and one also at the inner border, the largest artery being underneath, like the stem of a toadstool. From the adrenal glands thirty or more nerves emerge, and these are found on all aspects of the gland except the anterior surface where they appear at the borders.

In hyperthyroidism, the adrenal gland is greatly changed as to its vascularity, its adhesion to neighboring tissue, its appearance, and its texture, just as in hyperthyroidism the hyperplastic thyroid gland differs from the normal gland in respect to vascularity, adhesion, texture and appearance.

In the course of manipulation incident to the exposure of all aspects of the adrenal gland and to the division of the nerves, oozing and sometimes smart bleeding are encountered. In no case, however, have we found it necessary to tie a vessel because, happily, in this deep operative field clotting is spontaneous. This may well be accounted for by the fact that adrenalin facilitates the clotting of the blood, as demonstrated by Cannon.

Many years ago in researches on blood pressure, I found that, during manipulation of the adrenal gland, an immediate rise in the

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TECHNIQUE AND CLINICAL RESULTS

GEORGE CRILE M.D. F.A.C.S. CL. "ELA" D. ORE.

CL. 1 d CHICAGO

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Our first task was clearly to differentiate neurocirculatory asthenia from a group of diseases which present many symptoms in common. We clearly excluded the diseases analogous to neurocirculatory asthenia the mechanism of which involves changes in the

must be securely tied before the deeper dissection is begun. Since good exposure is essential, by means of a right-angled retractor, the twelfth rib is raised and the bloodless field is disclosed. After the renal fascia has been adequately incised a long vessel may be seen in the renal fat, the vessel which, as stated above, marks the trail to the adrenal gland. The first step is to mobilize the upper pole of the kidney and to depress the entire kidney when usually the yellow curved edge of the adrenal pancake may be seen. If the adrenal is not seen, the hand is introduced, and by palpation toward the vertebral column and the great abdominal vessels, the external ear-like border of the adrenal will be felt. At this point special instruments are introduced—namely, long, slender dissectors at one end of which is a dull dissecting blade and at the other end a blunt hook. In addition, we use a pair of blunt nerve hooks on a long shaft, a pair of French intestinal forceps, a tonsil dissecting knife, a fork retractor, and a pair of curved tonsil scissors (Fig. 3). These special instruments were constructed by Mr. V. B. Seitz, of the Cleveland Clinic.

The softness and brittleness of the gland precludes grasping it in an instrument in order to hold it and orientate its position and also, owing to the nerve and blood vessel attachments, the gland can be moved only within a very short radius. For these reasons the operation must be carried out essentially *in situ*.

After the gland has been exposed by separating the fat, the blood vessels are identified, and then, by means of the blunt nerve hooks, tonsil scissors and a long-handled tonsil knife, the nerves are divided. When this procedure has been completed, the adrenal gland will be quite mobile. It can then be raised up vertically from the vertebral column for a considerable distance.

Owing to the loose retroperitoneal tissue and the danger of oozing, we have usually inserted two cigarette drains, in the lumen of which iodoform gauze has been placed. The iodoform is used to prevent the contamination of the blood serum along the drains from a staphylococcus infection from the skin. The important point to remember is that, in

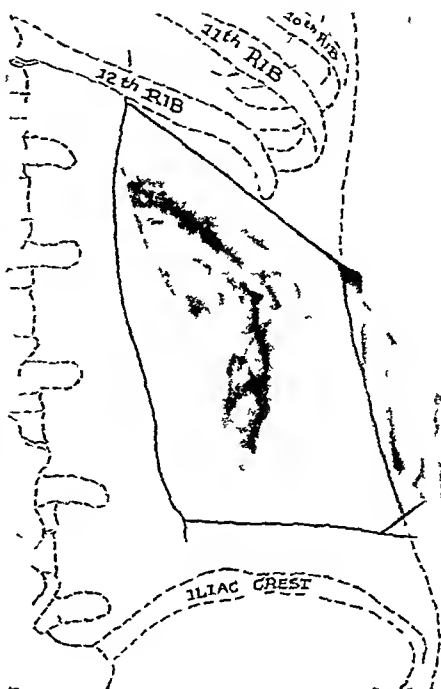


Fig. 2 Incision for denervation of the adrenal gland

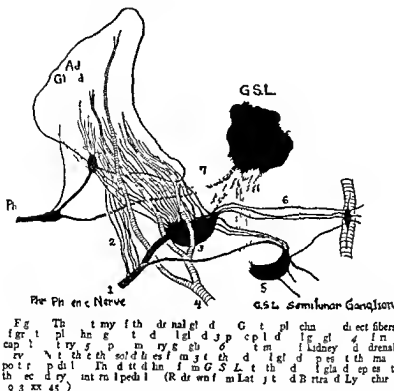
approaching the glands, rigid attention should be paid to land marks and the operating field should be bloodless.

IMMEDIATE OPERATIVE RESULTS

Since the operation is performed in a territory of meager sensory innervation, and the blood loss is slight, there is but little shock. In 126 cases, there have been no deaths from anaesthesia, pneumonia, shock, or haemorrhage. There have been two physiological deaths, but such deaths are now easily avoidable.

It is most important to state again that the clinical results in cases of diseases of mental or psychic origin, which may be confused with neurocirculatory asthenia, are negative. The differential diagnosis can be made with reasonable certainty by a careful history and physical examination.

The first point in the diagnosis is to make certain that the mental and psychic mechanism is normal. Then if an unstable heart is found, as manifested by tachycardia induced by trivial causes, or by no apparent cause such as by changing posture, by turning over in



arterial blood pressure occurred and that immediately after manipulation the arterial blood pressure fell

I found from these researches that the only gland or tissue in the splanchnic area the manipulation of which caused a rise in blood pressure was the adrenal. The manipulation of every other gland in the splanchnic area caused either a fall in blood pressure or produced no effect

TECHNIQUE

Except in cases of high blood pressure spinal anesthesia is the method of choice for denervation of the adrenal glands since it produces complete relaxation and lessens bleeding. The alternative to spinal anesthesia is local and regional block anesthesia combined with analgesia or with nitrous oxide or ethylene. If the operation is being performed under local and regional anesthesia then the adrenal glands themselves are blocked with novocain since although they lie among tis-

suces which are only slightly sensitive to pain they themselves are sensitive

In several cases with the patient in the prone position on the table we have made the approach along the lumbar muscles through a vertical incision believing that in this way we would approach the gland on its posterior aspect and by a shorter route. The special advantage of this method was that the nerves and blood vessels could be seen more directly but the procedure had limitations due to the position of the patient on the table

We have also made a vertical incision toward the anterior aspect of the adrenal along the tip of the twelfth rib but this method entailed too much contact with the peritoneum

Recently our method has been to make a modified kidney incision. This incision running from behind forward terminates at about the middle of the twelfth rib and is then carried downward vertically (Fig.) The incision must be large enough to admit the hand into the renal space. Every bleeding point

A NEW METHOD OF OPERATING FOR THE REPAIR OF RUPTURED CRUCIATE LIGAMENTS OF THE KNEE JOINT¹

WILLIAM R CUBBINS, M D, B S, F A C S, ARTHUR H CONLEY, B S, M D, JAMES J CALLAHAN, B S, M D, AND CARLO S SCUDERI, B S, M D, CHICAGO

From the Fracture Service of the Cook County Hospital Chicago

THE first attempt at repair of injuries to the cruciate ligaments was probably made by Hogarth Pringle, in 1907. The operation was next performed by Mayo Robson, and this procedure was reported later by Battle. The actual reconstruction of one of these ligaments was first undertaken by E W Hey Groves, of Bristol, England. In this first operation he utilized a band of fascia from the vastus lateralis, detached from its lower end, and passed it obliquely through the outer and posterior portion of the external condyle, obliquely down through the tibia in the direction of the normal anterior cruciate. He also suggested the use of the semitendinosus and gracilis tendons for the reconstruction of the posterior cruciate ligament. He suggested that these tendons should be carried through the posterior capsule and up through the anterior portion of the medial condyle.

Later Mr Alwyn Smith suggested that the upper portion of the vastus lateralis should be detached and dissected down so that it could be carried through the lateral condyle, leaving it attached at its lower end. He opened the knee joint by making a split patella incision, then carried this new tendon obliquely down through the head of the tibia, and reflected the excess portion that extended below, back upon the collateral tibial ligament as an adjunct to the strength of this ligament. It was his opinion that the instability in knee joints in which the cruciates had been repaired was due to a laceration of the collateral tibial ligament and that by strengthening it he could avoid this instability.

We are not able to understand why there is such a marked increase in the motion of a knee joint in which there has been a traumatic rupture of the cruciate ligaments as contrasted with the very limited motion when these ligaments have been divided in experiments upon the cadaver. We have sought for clinical rupture of the collateral tibial and

collateral fibular ligaments in about 200 severely injured knee joints, but as yet we have found no convincing evidence of the rupture of either one. In no instance have we been able to push the fingers between the condyles of the femur and the tuberosity of the tibia, and this would certainly be possible had there been a transverse laceration of either ligament. In one we thought there was a longitudinal separation of the fibers of the collateral tibial ligament, but in this case the skin over the supposed lesion was carefully dissected up and the ligament found intact, with no evidence of any rupture or detachment being present. In the joints that we have opened for ruptured cruciate ligaments, we have not observed any detachment of these ligaments from either the condyles or the tuberosities, and yet there has been an enormous amount of anteroposterior and lateral motion in both joints. This is more markedly evident when the individual is completely anesthetized. For these reasons we do not believe that the terminal portion of the fascial transplants reflected down upon the collateral tibial or collateral fibular ligaments will add very much strength to the joint. This was not done in either of our cases and yet the joints were very stable in spite of their marked lateral and anteroposterior motion before the operation.

A H Edwards, of Glasgow, reported in the *British Journal of Surgery*, 1926, an operation which he had worked out upon the cadaver, but which at that time had never been used upon the living. Mr Edwards made a long, medial incision which at its lower end curved across the leg anterior and to the outer side just below the knee joint. The joint was laid open by cutting the lower end of the capsule in front and chiseling off the tibial tuberosity, so that the patella and the other tissues could be laid back, making a complete exposure of the knee joint. He was very careful to avoid

¹Presented before the Clinical Congress of the American College of Surgeons New York, October 12-16, 1931.

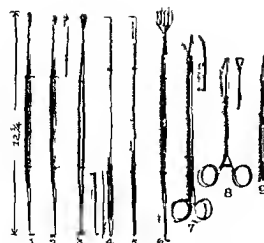


Fig. 3. Specimen of the thyroid gland, showing the results of the first denervation. The gland is shown in its normal position, and the results of the first denervation are visible. The gland is shown in its normal position, and the results of the first denervation are visible. The gland is shown in its normal position, and the results of the first denervation are visible.

bed by standing up by slowing of the heart rate when the patient bends over by any alterations in the heart beat up to and including paroxysmal tachycardia if the pupil dilate as the result of pressure on the region of the epistadium if hippus tremors sweatiness and cold hands and feet are present if there are unaccountable nervousness and tremors if there are intermittent nervous excitation and fatigue if infections and heart lesions are excluded then the diagnosis of neurocirculatory asthenia may safely be made

The heart can not initiate tachycardia but tachycardia is imposed upon it so the sympathetic system can not initiate stimulation

stimulation is imposed upon it. Our purpose in these cases therefore is to interfere surgically with this pathological stimulation by denervating the adrenal gland and we are finding the clinical results comparable to the results of thyroidectomy in cases of hyperthyroidism. So also soldier heart could have been relieved by adrenal denervation.

The day following the first denervation the patient will notice a lessening of consciousness of his heart he will experience a diminution of the feeling of nervous tension he will observe a lessening of the cold sweat a warming of the skin and the nurse will notice that the patient is less restless—a sequence similar to that which is observed after thyroidectomy in hyperthyroidism. If the first denervation produces none of the beneficial results it will be because the diagnosis is incorrect and the second denervation need not be performed. In correctly diagnosed cases the second denervation will be followed by further improvement along the same lines and the general improvement in cases continues steadily just as in the cases of hyperthyroidism.

Among the inconstant but frequent results is the disappearance of constipation and indigestion.

END RESULTS

As to the end results in our cases 1 patient has remained well for 14 years after unilateral adrenalectomy 1 for 4 1/2 years after unilateral denervation and of the 21 cases of bilateral denervation performed within the past 18 months 18 patients have remained well to date in 2 cases the results are negative and 1 patient we have been unable to trace. The final decision as to the potency of adrenal denervation must await the test of time.

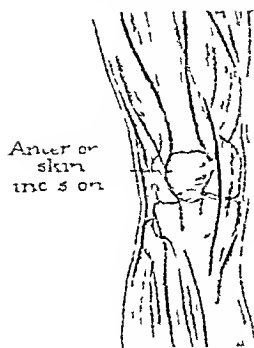


Fig 3 Incision medial to side of patella Anterior surface of knee joint

tibia back and up, almost to the posterior edge of the tibia and then bringing this ligament back through a hole drilled just above the medial condyle. There is no report of this procedure having been tried upon the living.

In relation to these operations suggested by Edwards and Eikenbary, we are certain that they will not produce a lateral stability in the knee joint, because the tendons are situated in the middle of the joint, the proximal and distal ends not being far enough separated to insure a lateral or anteroposterior stabilization.

The next contribution was published by William E. Gallie and A. B. Le Mesurier, in the *Annals of Surgery*, of 1927. In this article they suggest an operation for the repair of the posterior cruciate ligament. Dr Gallie's operation is very different from the preceding operations of Hey Groves and Edwards, particularly in that he does not detach the tibial tubercle and does not cut across the fascia of the anterior portion of the knee joint. He makes a long incision on the posterior surface of the thigh down to the upper portion of the calf. The tendon of the semitendinosus is exposed and isolated. It is then detached from the muscle as high in the thigh as possible and stripped downward to its distal insertion. The superficial portion of the split patella incision, which is used by this operator, is then made and the distal portion of the tendon grasped and pulled forward. A drill hole is now made through the tibial tuberosity into the popliteal space. The knee joint is then opened and this tendon

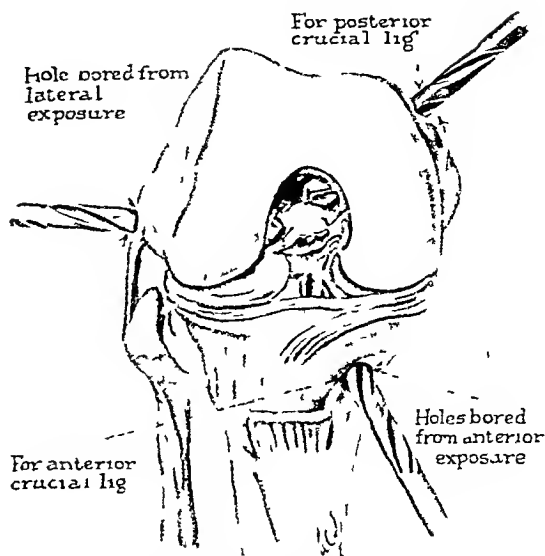


Fig 4 The bones are shown in outline. Note the points at which the drills are inserted from without in

carried up and back through the drill hole in the tibia to the popliteal space. From here it is passed forward through the posterior capsule into the joint. It is then brought out forward and through a drill hole in the anterior portion of the medial condyle. The joint is then straightened, and the excess of this tendon is carried out through the collateral tibial ligament and fastened on its surface in order to increase its strength. The split patella is then closed after the knee joint has been exposed a very short while.

We believe that this is a very excellent method of repairing the posterior cruciate ligament, but we do not believe that it is necessary to use it to reinforce the collateral tibial ligament, and we are sure that in some cases it may be a factor in limiting the flexion of the knee joint.

While we considered Gallie's method as an excellent procedure in the repair of this posterior ligament, we were a little hesitant about a deep dissection into the popliteal space and could not understand how we could use this method without either making two operations, or three incisions if we wished to repair both cruciate ligaments in one operation. It must be obvious that any operation which will reconstruct both ligaments at one

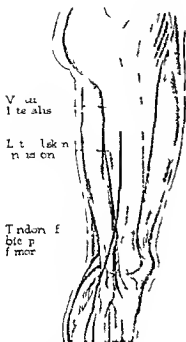


Fig. V. ul. l. te alus. L. t. lsk n. n. in on. Tendon f. bte p. f. mor. Th. d. l. f. m. n. h. w. n. w. b. t. Apo. s. d. t. d. f.

injury to the collateral tibial and collateral fibular ligaments. He then detached the tendons of the semitendinosus and gracilis from their distal insertion and dissected them up for about 10 inches on the inner side of the thigh allowing them to retain their proximal attachments to the muscles. These tendons were now carried through a drill hole in the medial condyle of the femur anterior to the tendon of the adductor magnus into the intercondylar notch. An opening was now drilled from the anterior and under surface of the medial tuberosity up to the position occupied by the spines of the tibia; an opening was also drilled through from the outer side and below the lateral tuberosity into the same opening. One of these tendons was then carried through this opening in the head of the tibia and fastened down to the medial anterior surface of the tibia and the other passed down to the lateral surface of the tibia through the same opening and both were sutured into the edges of the elevated periosteum.

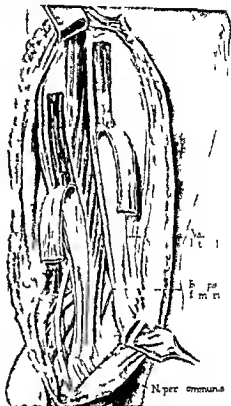


Fig. P. m. t. lat. l. d. m. l. f. p. or from b. ep. f. m. n. N. t. width f. f. se. it. p. d. point. t. wh. h. th. y. t. b. d. t. d.

In 1927 there appeared in SURGERY GYNECOLOGY AND OBSTETRICS an article by C. E. Eikenbary of Seattle Washington in which he suggested that these ligaments be made from a tendon secured elsewhere and that the entire operation be done through a long incision median to and parallel with the patellar tendon. He accomplished this for the anterior ligament by drilling through the crest of the tibia upward just in front of the anterior spine and then drilling a hole through the head of the femur obliquely back and down to emerge in the intercondylar notch on the medial surface of the lateral condyle. The new ligament was then passed through these openings and fixed by suture to the periosteum. The posterior ligament was made by drilling the hole in the crest of the

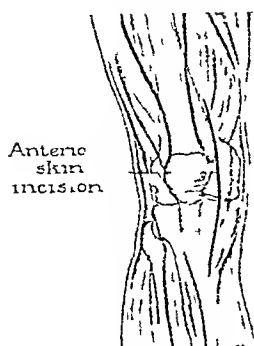


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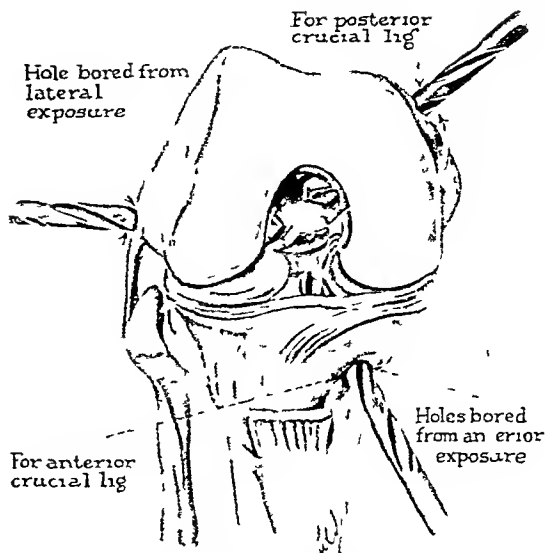
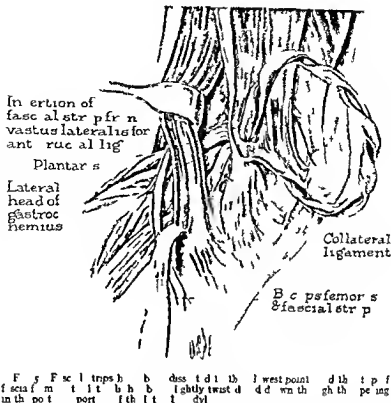


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sitting and thus avoid two separate surgical attacks upon the knee joint is the procedure to be desired

In studying the anatomy in this region we decided that the tendon and aponeurosis of the biceps (Fig 1) could be utilized. It was dissected loose from a cadaver its strength was carefully tested and we found that it would sustain about 35 pounds dead weight. This was considered of sufficient strength to justify its use in the construction of the new posterior cruciate ligament. A strip of the fascia from the vastus lateralis taken from the posterolateral surface will sustain about 75 pounds dead weight. We found that both of these new ligaments could be obtained through a posterolateral incision 12 inches long (Fig 2) extending from well above the middle of the thigh down over and about 1 inch below the head of the fibula. This approach also carries us to a point where both ligaments could be readily inserted into the knee joint

and these ligaments could be dissected loose and made ready for their new function before the knee joint was opened thus shortening the time exposure of the joint

The bicipital aponeurosis is dissected down off the muscle to the true tendon and about one third of the true tendon is separated down to the head of the fibula. One must make this dissection very carefully to avoid injury to this new transplant and a few muscle fibers will usually cling to the aponeurotic portion. Then a strip of the posterolateral portion of the vastus lateralis fascia about 1 inch wide is picked up and dissected down until it reaches that portion which is seen to curve slightly forward and anterior. This is exactly opposite the posterolateral portion of the lateral condyle as is shown in Figure 2. These new ligaments should be about 10 inches long.

At this stage of the operation we can clip the edges of this wound together if we wish or

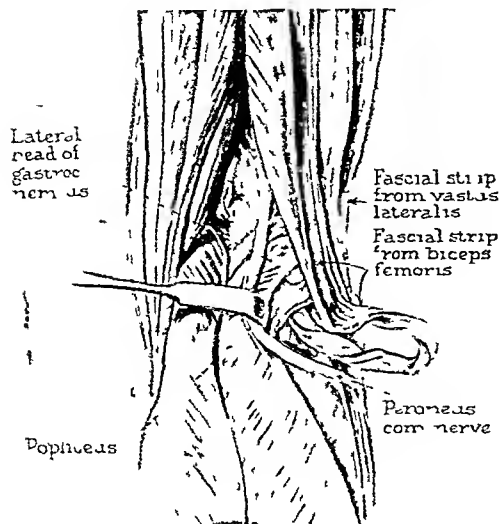


Fig 6 Point at which the slightly twisted aponeurosis and tendon of the biceps are carried up beneath the popliteus and lateral to the outer head of the gastrocnemius and peroneus communis nerve

merely cover with a towel and then open the knee joint through the incision shown in Figure 3. In those cases in which both of the cruciate ligaments have been ruptured, this incision will give a wide exposure, so that every anatomical detail of the joint can be carefully observed and any loose fragments of cartilage or injured menisci easily removed. In our cases, we were not able to see any remnants of the injured cruciate ligaments or any injury to the menisci. The condyles and tuberosities were widely separated, and a careful inspection could be made very quickly. These remnants had probably retracted down into the synovial sheath.

A three-eighth inch drill opening is now made through the medial condyle at its anterior and upper portion above the cartilaginous line, obliquely back and down to the upper portion of the intercondylar notch at a point where the anterior insertion of the posterior cruciate is normally situated (Fig 4). Another drill hole is made in the medial surface of the medial tuberosity of the tibia, emerging in the upper surface of the tibia just in front of the anterior spine (Fig 4).

The lateral incision is then opened and a hole is drilled through the posterior portion

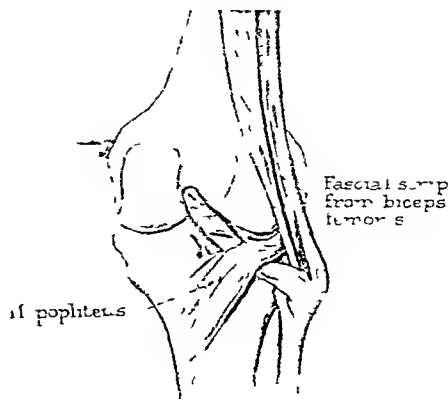


Fig 7 The course of the new posterior cruciate ligament is shown in outline as it passes from the fibular head beneath the tendon of the popliteus muscle and medial to the curved inner portion of the lateral meniscus

of the lateral condyle just above the collateral fibular ligament, extending transversely into the knee joint to enter the upper posterolateral portion of the intercondylar notch, at the point where the anterior cruciate originates (Fig 4).

As you have noticed, all holes are drilled from without in and the drill will bring most of the debris out as it is retracted. If any free fragments are detached they are removed at once in order to avoid a free body that certainly would cause serious difficulty later.

In Figure 5 we see the fascial strip from the vastus lateralis, which is intended for the anterior cruciate ligament, being drawn through a hole in the lateral condyle just above the collateral fibular ligament. We also see to what point the tendon of the biceps has been dissected.

In Figure 6 we see how the tissue for the new posterior cruciate ligament is carried lateral to the head of the gastrocnemius and peroneus communis nerve, then beneath the tendon of the popliteus to where it is pushed through the posterior ligament of the knee joint just lateral to the oblique popliteal ligament and medial to the curved posterior border of the lateral meniscus, as shown in Figure 7.

If one will study the illustrated anatomies of the knee joint, he will observe just how the posterior portion of this posterior cruciate ligament extends down over the posterior

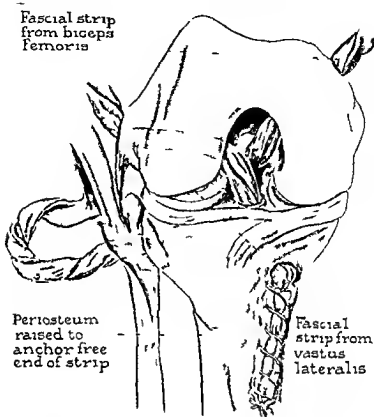


Fig 8 Ap t f th w nt n t tp bt nth ndyl
dth p st wh th w p t n ru t b nd th t p t l b d
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border of the head of the tibia and thus new posterior cruciate ligament arising from the head of the fibula follows the exact course of these fibers. Consequently this new posterior ligament should be able to meet the strain of normal knee joint action.

In Figure 8 we see these ligaments in outline and in particular we see that the anterior cruciate passes directly through the lateral condyle and then obliquely downward and forward through the head of the tibia. We are also able to note the oblique direction of the posterior cruciate as it is pulled up through the medial condyle giving these ligaments their normal relationship.

An incision 2 inches long is now made through the synovia and periosteum of the femoral head extended upward above the

drill hole and the periosteum dissected up in order to form a new bed for the attachment of the posterior ligament. A like incision is now made in the anteromedial surface of the tibia below the drill opening. The knee joint is now flexed about 25 degrees the new ligaments are drawn taut and their terminal portions are sutured firmly into the new osteo-periosteal beds (Figs 8 and 9). There should be only a slight twist in these ligaments in fact just enough to prevent their fraying when they are drawn through the bony canal because any marked twisting would interfere seriously with their nutrition.

We have made no attempt at covering these ligaments with synovia as suggested and carried out by Dr Gallie because we are certain that if most of the synovial mem-

brane of a joint can be regenerated following its excision in the treatment of chronic arthritis, these ligaments will be covered with synovia at an early period. We are also sure that they will grow firmly into their new locations, both in the bony canal and in the osteoperiosteal beds into which they are buried. In one case which was done in two steps, the new anterior cruciate ligament which had been made 10 weeks previously was pink and healthy, and the wounds in the bone filled with firm fibrous tissue of obviously recent growth. This confirms the observations made by Gallie and his associates in their experiments upon animals.

We have not found any evidence in the literature that the aponeurosis and tendon of the biceps had been used previously in the reconstruction of these cruciate ligaments. The method of making the anterior cruciate is similar to that of Hey Groves and Alwyn Smith, with the exception that we do not imbricate it over the collateral tibial ligament. We did one operation in which we reconstructed both cruciate ligaments in one sitting and the knee joint is stable and strong, with a full range of motion. In another case we did the operation in two steps, making the anterior cruciate first and, about 10 weeks later, making the posterior, using the aponeurosis and tendon of the biceps muscle for the new ligament. This joint is also stable in spite of the fact that, to test its firmness, he removed the splint and walked upon the limb during the first 24 hours after operation.

It would be well to state here the effect upon the biceps muscle of having the aponeurosis removed. We have not opened any of these wounds, consequently, we have not had the opportunity to observe whether it would or would not regenerate. But there is no question that the muscle feels thinner and softer and that the sharp edge which is so easily palpable beneath the skin is nothing like so well marked. However, there has been no complaint as to either loss of strength or interference with function.

The preparation for these operations should be made with extreme care. Eighteen to 24 hours prior to the operation the limb is shaved to the buttocks, scrubbed with soap and

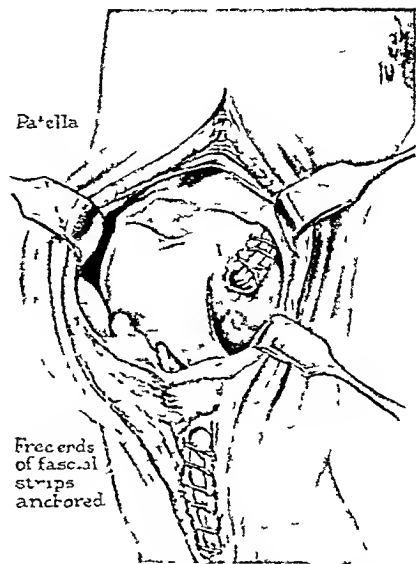


Fig 9 The tendons in outline and their relations in the intercondylar notch. Note how the terminal portion of the new tendon is buried in the osteoperiosteal bed.

water, washed with 60 per cent alcohol and dry sterile dressings are applied. When the patient is anesthetized, a Martin bandage is applied, extending from the toes up to the top of the thigh. Then a very strong tourniquet of some type is applied, and the Martin bandage is removed from the lower portion of the limb, thus leaving it almost bloodless.

The lateral incision, as already stated, is made first. The gaping mouths of blood vessels are easily visible and are clamped and tied with very fine plain catgut. As a rule there are only two locations where these are found, they are the peri-articular vessels above the condyles and opposite the articulation on the inner side of the knee joint.

In closing the wounds, we have deviated materially from the standard used by many orthopedic surgeons, in that we have avoided a complete water-tight closure. The capsule and synovia of the knee joint are closed from above down with a continuous stitch, until we arrive opposite the articulation. Here a space of about 1 to 1½ inches long is allowed to remain open, so that the extravasated blood and synovia can escape from the knee joint. The skin is closed with Michel clips, spaced about seven-eighths of an inch apart. This

spacing of the Michel clips does not interfere with the extravasation of the fluid. When the dressings have been applied the tour nouet is removed.

The limb is supported in an angle of 25 degrees of flexion with a long posterolateral molded splint of plaster-of-Paris and the entire mass is placed in a curved Thomas splint which is supported from a Balkan frame about 14 inches above the bed.

Dressings are changed at the end of the first 6 hours. In our experience with these and other knee joint operations we have found that only three changes of dressings were required in the first 48 hours. The third change usually finds the dressings almost dry and after that they are allowed to remain *in situ* until the clips are removed on the eighth day. No washing or cleansing of the wounds is done. Dry sterile dressings are applied with forceps.

At the end of about 4 weeks the cast is removed and the limb is placed in a straight angle in a Thomas splint. Passive motions are now begun and at the end of 6 weeks active motions are allowed. We have permitted no attempts at walking until about 14 weeks have elapsed. Then if the patient is able to buy a brace for the knee joint we believe it to be advisable as it would be excellent protection against an accident and stretching of the new ligaments. In our cases this was not possible but in spite of this both knee joints are strong and serviceable. They

are not perfect but the individual are able to use them in a satisfactory manner and they are very much pleased with the result. There is a slight lateral motion of the extended leg and a little excess of anteroposterior motion with the limb flexed but this increase in motion apparently causes no disability. When it is understood that these joints were utterly useless previous to the operation it seems to us that these results should be considered a great victory.

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SOME EXPERIENCES IN THE TREATMENT OF CARCINOMA OF THE RECTUM WITH RADIUM¹

SIR CHARLES GORDON WATSON, K B E, C M G, F R C S, F A C S (HON.), LONDON
 Surgeon St Bartholomew's Hospital

DURING the past 7 years I have endeavored to assess the value of radium as an adjunct to, or substitute for, surgery in cases of carcinoma of the rectum. In this period I have made over 200 applications of radium employing various methods described elsewhere.²

I endeavor to secure a uniform barrage of both the growth and the lines of lymphatic spread with the aid of surgery. In the time at my disposal it is not possible to consider either methods of approach or the very important details of dose, filtration, and length of exposure. Success depends almost entirely on uniform irradiation and a correct assessment of the optimum dose, which means a proper adjustment of three factors, radium quantity, time, and filtration. Given the optimum dose, success can only follow if the entire growth is attacked in a uniform manner and lymphatic spread is prevented. It is, therefore, apparent that there are many loopholes for failure. Only by prolonged experience can one hope to be able to prescribe the correct dose and the ideal method of application for any individual case. I recognize that I stand only on the threshold of this problem. In matters surgical we have behind us the accumulated experiences of generations of surgeons; it must be many years before we learn through the experience of others to standardize our technique in radium therapy.

At the present time the difficulties associated with the irradiation of carcinoma of the rectum are so great that it is impossible to appraise its value without much more experience than I have been able to get. Nevertheless I will try here to convey my impressions of its value as a method of treatment.

RADIUM FOR OPERABLE GROWTHS

I am satisfied that, with our present knowledge, the results of treatment are too un-

certain to justify the use of radium as a routine measure in preference to radical surgery in *those cases in which there is a reasonable prospect of successful radical surgery*. It is a tempting proposition to endeavor to remove an early rectal growth with the aid of radium, to leave an intact rectum with normal function, and to avoid a colostomy. We can attack the tongue in this way, and be confident of a cure in a large percentage of cases but we cannot control or stop lymphatic spread without the aid of surgery in most instances.

In cancer of the rectum, lymphatic spread does not occur until the growth has penetrated through the muscular wall of the rectum, and if often happens that the lymphatics are found to contain no metastases even though the growth has invaded the perirectal tissues.

Consequently, if the rectal growth responds well to radium the chances of cure are better than in the case of the tongue. Unfortunately, adenocarcinoma is more radioresistant than squamous carcinoma. Although just as the more malignant grades of squamous carcinoma are more radiosensitive so I think it will turn out that the more malignant grades of adenocarcinoma are more sensitive to radium. More observations on this point, however, are required. The grading of this type of growth is not easy as different areas of the same growth when examined histologically sometimes fall into different grades.

The rectum is at a great disadvantage when compared with the tongue because the exposure necessary for an accurate barrage is more often than not extremely difficult to secure. In the early days of radium therapy the method of approach to the rectum was by means of a tube containing radium in bulk, which was inserted into the lumen of the rectum and which usually was insufficiently filtered to cut out the bulk of the β -rays. It was seldom if ever possible by this method to give uniform irradiation to a rectal growth

²Brit J Surg 1930 xvii 65

¹Presented before the Clinical Congress of the American College of Surgeons New York October 1-16 1931



Fig 1, left Case of M A M, aged 69 years Small operable growth was situated in the posterior wall of the rectum $1\frac{1}{2}$ inches from the anal margin. No cystostomy was performed. On May 27, 1929, radon seeds were inserted intrarectally—8 seeds at 2 millicuries. A dosage of 1,729 milligram hours being given. Section of growth showed columnar cell carcinoma.

Fig 2 W S, aged 40 years. A fixed inoperable growth was located 2 inches from the anal margin, and completely surrounded the bowel. On March 25, 1929, colostomy was done and 5 radon seeds were applied to mesorectum and 5 to the growth per rectum, a total dosage of 3,325 milligram hours being given. On July 1, 1929, 6 radium needles, 2 milligrams, were inserted into growth per rectum (evenly distributed) and a dosage of 1,956 milligram hours was given. Section shows columnar cell carcinoma.

deserves consideration. Injudicious treatment of this class of case may do more harm than good. On the other hand it is sometimes possible to produce such improvement that the growth shrinks and ceases to be fixed to surrounding structures and is converted from an inoperable into an operable growth.

On three occasions I have carried out successful excisions in cases regarded as inoperable before radiation treatment. Very advanced cases with perirectal infection are unsuitable for radium.

Many inoperable cases have been treated after preliminary colostomy. When response is good the growth is largely replaced by fibrous tissue. Cicatricial contraction follows and ultimately fibrous stricture. Such a case as this may remain quiescent for many years and the patient remain free from symptoms.

In other instances of advanced cancer in which there is no hope of rendering the case operable or converting an active cancer into a quiescent fibrous stricture, radium has been employed in a less radical manner to relieve excessive discharge, discomfort, and pain by intrarectal application of radon seeds, thus avoiding all surgery which might aggravate the disease or excite sepsis.

The younger the patient and the higher the

grade of malignancy the more rapid is the growth. Metastasis occurs early and operative prognosis is bad except in the very early stages. These cases usually respond well to radium, and if regarded as too advanced for excision are not altogether without hope, if radium treatment is prompt and thorough. I can instance a few cases to support this view.

Speaking broadly, the best field for radium in the light of our present knowledge is the conversion of a fixed inoperable growth into a less fixed growth which becomes suitable for radical excision.

Perineal recurrence following the modern method of excision is not very frequent. Such cases are usually beyond surgical aid. I have been able, in a few instances, to check the disease by destroying the recurrence. One of these patients is carrying on 2 years after irradiation and 6 years after excision.

ABDOMINAL RADIATION

When a rectal carcinoma extends above the peritoneal reflexion, it cannot be treated from below. I have treated a number of cases by transperitoneal attack, and the first case treated in this way nearly 4 years ago remains well and free from evidences of growth, and is without colostomy.

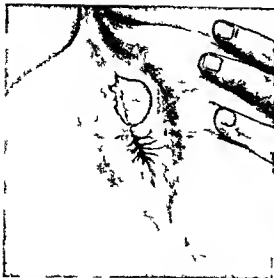


Fig 3. The patient is in the lithotomy position. The growth is situated at the pelvic junction and was fixed to the sacrum with adhesions to the bladder. Unfortunately, I have not been able to repeat this success. An initial success so striking is not easy to explain in the light of subsequent failures.



Fig 4. H. C. Geddes, Jr., M.D., of the University of California, San Francisco, California. The growth was situated at the pelvic junction and was fixed to the sacrum with adhesions to the bladder. Unfortunately, I have not been able to repeat this success. An initial success so striking is not easy to explain in the light of subsequent failures.

The growth was situated at the pelvic junction and was fixed to the sacrum with adhesions to the bladder. Unfortunately, I have not been able to repeat this success. An initial success so striking is not easy to explain in the light of subsequent failures.

There are certain definite dangers. There is a risk of leakage from perforation through penetration of the lumen with needles. A certain amount of plastic peritonitis with effusion results from the irradiation and serious trouble may arise if drainage is inadequate. Later on I have experienced trouble from adhesions. Intestinal obstruction has been caused by adhesions of the small intestine to the radiated area.

In some instances very marked improvement has followed without complete retrogression. At the present time I do not use radium within the abdomen to attack the growth unless radical surgery is ruled out. I have found it advisable to isolate the radiated area with rubber tissue to allow free drainage to perform a colostomy but to avoid opening it if possible until the radium has been removed if needles are used. If radon seed are used they may be left in the difficulties and dangers are diminished but the absence of a constant radiation seems to be less effective.

RADIUM ASSOCIATED WITH RADICAL SURGERY

There is another field for the use of radium that is in conjunction with radical surgery.

In most instances when I open the abdomen to explore and to carry out colostomy as a preliminary to excision I employ radon seed to barrage the lines of lymphatic spread upward along the superior mesenteric vessel. The seed are inserted beneath the peritoneum and no drainage is required.

It will be many years before the value of this procedure can be assessed in the follow up of excision cases. One case suggests that this procedure is of considerable value.

I the f a d e d g w h n a y g
w m t t h t m f l a p o t m y l l g e d
g l d w t d a l g t h s p r h a m r h d l
l Th e g l a d d t d w t h d
d t d d c t l y t t h g l a n d s O g l a d
s m d f b p y d f u d t b e f i l t d
t h d c c m The c t l g o w t h s
d i d t t t t Th p t t d f m

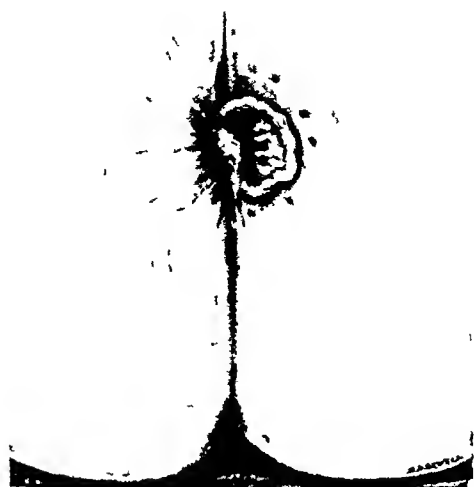


Fig 5 Epithelioma of the anus before irradiation with needles

intestinal obstruction one month later. Careful histological examination was carried out of the rectal growth and perirectal tissues. The growth had been destroyed, but the rectal tissues still showed evidence of carcinoma. Examination of the glandular area failed to reveal any evidence of metastasis.

It often happens when carrying out an excision on a borderline case that the growth turns out to be more fixed than anticipated and the surgeon is faced with the fact that, although he has excised the rectum, malignant infiltration of the perirectal tissues may have occurred beyond the limits of excision. Then radium should be used to supplement surgery.

EPITHELIOMA OF THE ANUS

Squamous cell carcinoma of the anus has proved to be very responsive to interstitial radiation, and results are far better than for adenocarcinoma of the rectum. Surgery, at its best, involves a permanent colostomy. Radium can and does leave an anus which functions normally. It is often necessary to dissect out glands in the groin. Anal growths are not always squamous celled.

I have treated an adenocarcinoma occurring in the anus in the scar of an old fistula with



Fig 6 S S, aged 52 years. Result of irradiation of epithelioma of the anus. Note loss of sphincteric pucker and smooth scar on left side of anus. Two years and 6 months after treatment.

radium and secured a perfect result with a soft pliable cicatrix and normal function. After 6 months, recurrence occurred with enlarged glands in one groin. Excision was then carried out with removal of glands.

This case illustrates the difference in response of the two types of growth. It is possible that with improved technique we may be able to prevent these recurrences. So far the cases of squamous carcinoma have not shown much tendency to recur.

I have endeavored to show what radium can do and how it fails. I recognize that there is much more to be done before we can attempt to dogmatize. In the present state of our knowledge I regard radium as a useful adjunct to surgery in skilled hands, and as a dangerous weapon in unskilled hands. It cannot replace surgery in rectal cancer, though it bids fair to do so in epithelioma of anus.

The rectal surgeon should regard radium as a spare horse to his team. He must recognize that this spare horse is not fully broken and is capable of dangerous antics. When harnessed to the team, a careful and experienced driver is required, if disaster is to be avoided.

CURABILITY OF CANCER OF THE STOMACH¹

DONALD C BALFOUR M.D. F.A.C.S. R. CHESTER MIN. ESO. A

THE fact that cancer of the stomach is curable is often obscured by the prevailing attitude of physicians and of laymen toward the disease. Although cures are rare, they are to the surgeon a constant reminder of his responsibility and of the fact that only he can offer the patient a possibility of cure. I am convinced that a more widespread understanding of the reasons why the patient with cancer of the stomach is usually denied any chance of cure will greatly increase the proportion of cases in which resection is possible and will at least extend to such patients the benefits temporary or permanent which may accrue from thorough removal of a localized lesion. In the hope that study of a group of cases of cancer of the stomach in which cure has been obtained may reveal information of value in treatment of this disease, I am presenting an analysis of the histories of 128 patients for whom partial gastrectomy for cancer of the stomach was done in the clinic between 1910 and 1920 and who lived 10 years or more following operation. Approximately 50 per cent of patients with cancer seen in the clinic during 1910 to 1920 were operated on, and in 39.3 per cent of these cases the cancer could be removed; these represent 19 per cent of the patients with gastric cancer who were seen.

In the last decade, 1920 to 1930, resection was possible in 43.16 per cent of the cases in which exploration was carried out, and this represents 22.62 per cent of the patients with gastric cancer who were seen. The present situation, therefore, is that in about half of the cases of cancer of the stomach exploration is warranted and in about half of these the growth can be removed. These figures mean that at present an attempt at cure can be made in less than 25 per cent of cases of cancer of the stomach.

Careful study of the histories of these 128 patients who lived ten years or more following resection for cancer emphasizes the great variability in the disease. There is no characteristic syndrome of cancer of the stomach.

Although there is a more or less constant syndrome in the average case, there are so many exceptions to the rule that the astute clinician will by keen recognition of this fact establish a diagnosis of the disease at a time when the symptoms are hazy and when surgery can offer some prospect of cure.

The average age in this group of patients was 52 years, but there were two patients aged between 20 and 30 years, respectively, and the ratio of males to females was 3 to 1. In 16 per cent of cases the family history was positive for cancer. The most striking fact in the history was that in 109 of the 128 cases dyspepsia had existed for a year or more. In 16 per cent there had been gross bleeding, and in 114 of the 128 there had been some loss of weight. Anæmia was seldom marked; the average concentration of hæmoglobin was 60 per cent, and in 75 per cent of the cases it was more than 50 per cent. Analysis of gastric content in these cases emphasized its unreliability as a diagnostic aid; for in 50 per cent of the cases the concentration of free hydrochloric acid was normal or above normal. In 30 per cent of the cases some degree of retention was present.

The site of the growth was about equally divided between the antrum and body of the stomach; 51 per cent of the growths were classified as pyloric, and 49 per cent did not extend to the pylorus. In 33 per cent of the cases lymph nodes were shown to be involved by microscopic examination.

Grading by Broders of the tumors in the cases in which cure followed removal showed that only 10 per cent could be graded 4, that is, as highly malignant; 55 per cent were graded 1 or 2, a relatively low degree of malignancy. These figures confirm the value of microscopic grading in these cases, as an aid to prognosis and as an indication for resection.

The types of operation employed in this group show the modifications in technique as developed during that period. In the earlier cases the Billroth II operation was almost always used; then came the Pólya type, which shortened the time of operation and proed

equally satisfactory in other respects. It is of interest that in 6 cases in this group of 128 cured patients, local excision only was done, and that in only 4 cases was the Billroth I operation done.

This study has served to emphasize certain facts which are, in part at least, responsible for the present appalling situation, namely, that in a disease in which cure is possible, not even an attempt at cure can be made in 75 per cent of the cases when the patients are first seen. There are two major reasons for such a situation: the nature of the disease, and the delay in diagnosis and, consequently, of surgical treatment. It is these two factors which I wish first to consider.

THE NATURE OF THE DISEASE

It is unfortunately true that in a considerable number of cases of cancer of the stomach, the disease begins in a situation in which removal of the growth is prohibited even if diagnosis is early. A lesion in the fundus is the most unfavorable for many reasons, but chiefly because early symptoms are few and insignificant, and also because the lesion is relatively inaccessible. This is particularly true of lesions which involve the upper limits of the lesser curvature, for then the only procedure possible is total gastrectomy, and experience has shown that a lesion that is more or less confined to the lesser curvature is not the type of cancer for which total gastrectomy is indicated. When a high lying cancer is shown, roentgenologically, to involve chiefly the greater curvature and when the growth is palpable and movable, exploration should always be advised, since tumors which involve the posterior wall and greater curvature, even if they are high in the fundus, often can be mobilized and removed satisfactorily with prospect of cure. A most important fact in regard to any high, irremovable lesion is the possibility that it may be benign, and in prognosis this should always be taken into consideration if establishment of diagnosis by biopsy has not been feasible.

Lesions of the antrum, and those which extend to the pylorus, are commonly supposed to be the most favorable for both removal and cure, but this study has not confirmed such a

view. The reason why the pyloric situation is not the most favorable is that the adjacent lymph nodes in this region are extensive, become involved early, and cannot be as thoroughly removed as the regional lymphatic structures of other segments of the stomach. Penetration posteriorly occurs earlier when growths are in this situation and this greatly decreases the possibility of cure. It is largely for these reasons that lesions at or near the outlet, from the standpoint of curability, take second place to lesions of the body of the stomach.

Cancer of the body of the stomach, if well demarcated, is most curable of any because of its accessibility, because of the completeness with which regional lymphatic structures can be removed, and because the mortality rate which accompanies resection of such growths is lower than that of resection of growths in any other situation in the stomach.

The size of a tumor of the stomach may give an erroneous impression as to operability. A large, freely movable cancer is more likely to lend itself to removal, as a rule, than is the cancer which cannot be palpated. Large tumors are usually of the colloid type, the lesion is sharply demarcated, and the walls of the uninvolved portion of the stomach are flexible, and, therefore, suitable for extensive resection and safe anastomosis. These facts are of practical importance, since it is a common impression that the large gastric tumor is irremovable, and that for this reason operation is not advised.

DELAY IN DIAGNOSIS

The chief reason for the fact that in only 25 per cent of the cases can the growth be removed, is failure to make an early diagnosis. So many factors contribute to this that I shall not attempt to consider them in detail. It cannot be too strongly emphasized that it is extremely difficult for even the most able clinician to make an early diagnosis of cancer of the stomach. The fault does not lie with the clinician but with the fact that symptoms and signs are either lacking or most insignificant in the early stages of the disease. The experienced clinician, recognizing this, will not delay until definite symptoms and signs ap-

pear but will on suspicion demand not one but repeated fluoroscopic examinations by a competent roentgenologist. Such a clinician will not be deluded into believing that a patient who is in apparent good health with normal values for gastric acids with no loss of weight with no palpable tumor but with unexplained dyspepsia cannot have cancer of the stomach. The first step therefore in successful treatment of cancer of the stomach depends on the wise clinician and a competent roentgenologist. It is of course most unfortunate that since the early symptoms of cancer of the stomach are so slight patients do not seek advice early, a situation to be met only by public health education and periodic examination.

SURGICAL TREATMENT

Following recognition of a lesion of the stomach the responsibility must be assumed by the surgeon. It is good practice to follow a rule that in all cases of cancer of the stomach exploration should be carried out unless recognizable irremovable metastatic growths can be demonstrated. Exceptions include cases of elderly patients in which roentgenologic examination results in the lesion being pronounced inoperable and those in which there is clinical evidence of the cardia being involved. For young patients whose condition is not too poor a fluoroscopic report of inoperability should not necessarily contraindicate exploration since occasionally removal is possible under such circumstances. When rectal, umbilical or supraclavicular implants can be demonstrated operation is in advisable except for obstruction of high grade then gastroenterostomy under local anæsthesia may be worth while to the patient.

Surgical treatment has two purposes in view cure and palliation. Since this paper is concerned with the question of cure I shall not consider palliation except to say that intelligent efforts at palliation especially by partial gastrectomy offer much to these patients. I have been much impressed with the number of patients who have lived in comfort 2, 3 or 5 years following palliative resection that is patients who have irremovable metastatic growths. Removal of a cancer of the stomach

with reconstruction by the Billroth II method or one of its modifications gives almost certain assurance that obstruction will not develop if death occurs it is due usually to metastasis to the liver which so far as pain is concerned is relatively symptomless. It should be mentioned that a most effective surgical method of palliation when the growth cannot be removed is exclusion of the growth by division of the stomach above it closure of the end of the involved segment and restoration of continuity by an end to side gastrojejunostomy. In carefully selected cases gastroenterostomy alone gives real protection against disagreeable symptoms or it may give some prolongation of life.

Maximal prospects of cure are attained by wide removal of the growth and removal of lymphatic structures. The limitations of removal rest to a considerable extent on the experience of the surgeon and on his willingness to undertake extensive resections with their increased mortality rate. At the operating table the decision of whether resection of the stomach is warranted is sometimes difficult to make. A safe rule is that if the disease is confined to the stomach removal unless it requires total gastrectomy should be indicated.

The operation of total gastrectomy for cancer is justified only in those cases in which the stomach is sufficiently mobile that reasonable access to the œsophagus can be secured and safe anastomosis between jejunum and œsophagus accomplished. Resections of less extent usually can be carried out if the disease is well demarcated and if the uninvolved portion of the stomach lends itself to safe anastomosis with the jejunum. The usual types of cancer that is the ulcerative or the colloid type are well demarcated but in the linitis plastica type it is not only difficult definitely to decide on the line of demarcation between diseased and normal tissue but permanent cure in such cases is extremely rare. A most important point is that in some of the larger tumors the uninvolved portion of the stomach above the growth may appear to be malignant tissue because of rigidity and thickening of the gastric walls and may lead the surgeon to decide against resection when the prospect of cure

may really be good. A further important fact in determining operability is to withhold decision until the patient is completely relaxed under anæsthesia and until any adhesions which can be divided have been severed. It is not an uncommon experience that a growth, examined while the patient is straining under light anæsthesia, appears irremovable, but that it proves under deep anæsthesia to be readily removed.

The regional lymphatic structures are large factors in treatment of cancer of the stomach. The four main groups—the suprapyloric, the subpyloric, and those of the greater and lesser curvatures, are sufficiently accessible that they can be removed with reasonable thoroughness. There are two facts of great importance regarding enlarged lymph nodes in cancer of the stomach: (1) enlargement does not necessarily mean involvement by cancer and (2) a patient may be cured even if all involved lymph nodes are not removed. The first fact is well known and undisputed and its practical importance is that it impels the surgeon to avoid the mistake of assuming incurability because of marked and extensive enlargement of regional nodes, a fact to which W. J. Mayo early drew attention. The second point is less easily substantiated, but sufficient examples are found in this series of cases of cured patients, in which the surgeon considered the resection only palliative because of incomplete removal of an involved chain of lymph nodes. I believe it to be a possibility that in cancer in any situation, removal of the primary growth and of the immediately adjacent lymphatic structures may bring about permanent cure even if involved lymph nodes are left, the remaining nodes in such cases act as a sufficient barrier to further dissemination of the disease. It is, therefore, occasionally good practice to disregard involvement of lymph nodes if the primary growth can be removed, and to remove the adjacent lymphatic structures as completely as possible.

The methods by which resection of the growth is accomplished are numerous. The surgeon acquires a preference for those methods which have served well. For this reason I believe that in all resections for cancer, the duodenal stump should be closed and gastro-

intestinal continuity restored by union between the remaining portion of the stomach and the jejunum. This principle has the advantage that, should recurrence take place, it is not associated with obstruction such as occurs if the resection has been of the Billroth I type. The methods of uniting stomach and jejunum will vary with the extent of the disease, condition of the patient, technical difficulties, and so forth. In a general way the more extensive the resection the more likely is an end- (stomach) to-side (jejunum) anastomosis with enteroanastomosis to be a safer procedure than others. In those cases in which the resected portion includes the greater part of the lesser curvature, or when the lesser curvature is friable or particularly difficult of access, a Billroth II, either posterior or anterior, is an excellent procedure. This method has the advantage of permitting safe and aseptic closure of the end of the stomach, and a small, secure anastomosis between stomach and jejunum.

The safety with which such procedures can be carried out is determined chiefly by the following: (1) pre-operative preparation, (2) anæsthesia, (3) selection of the operative procedure, (4) duration of operation and its technical perfection, and (5) after-care.

The preparation for operation of the patient with cancer of the stomach has two purposes: (1) cleansing of the stomach, and (2) correction of dehydration. These usually can be accomplished in 2 or 3 days, by performing gastric lavage as frequently as conditions dictate, and by intensive administration of fluids, solution of glucose and of physiologic solution of sodium chloride as indicated. Anæmia associated with cancer of the stomach, unless it is directly due to gross hæmorrhage, is not combated by transfusions. In addition, due regard should be given to the danger of the toxæmia of obstruction.

Anæsthesia, since pulmonary complications are the chief menace in such operations, is of great importance. Anæsthesia by inhalation should be as innocuous and as brief as possible. Ethylene has, therefore, definite advantages. My preference in the cases of more serious risks is for preliminary medication with barbiturates, abdominal wall block, and as much

ethylene as necessary. Spinal anæsthesia for extensive resections is in my experience not as safe a method of anæsthesia as the combination mentioned. I have been much impressed with the advantages of intratracheal anæsthesia for the obese anæmic patient.

Selection of the type of operation is a large factor in the safety of resection. The procedure which is associated with the least technical difficulties commensurate with thorough removal of the growth is the best. As I have stated, an anastomosis in front of the colon has distinct advantages in extensive resections and is unquestionably safer than other procedures.

The details of technique are not within the scope of this paper, but it is pertinent to emphasize scrupulous cleanliness, absolute hæmorrhage, carefully approximated suture lines, sufficiently reinforced and satisfactory mechanics. In extensive resections and particularly in total gastrectomy, a catheter inserted directly into the jejunum and left in place for introduction of fluids and nourishment is unquestionably a factor of safety.

The after care in cases of partial gastrectomy for cancer should be as simple as possible. Adequate intake of fluid by proctoclysis

should be maintained or if proctoclysis is not tolerated by intravenous administration. The stomach should be kept clean by aspiration when necessary and taking of fluid by mouth should be forbidden for 48 hours or more. Transfusion in cases of bad risk is more useful when it is done immediately after operation than it is when done previous to operation or late after operation.

The mortality rate of partial gastrectomy for cancer of the stomach under the foregoing regimen should be less than 10 per cent. In the last 200 cases in which I have done partial or total gastrectomy for cancer of the stomach, there have been 10 deaths in hospital, a mortality rate of 5 per cent. Such a death rate in a disease in which an early and distressing death is inevitable is not high and emphasizes the indication for surgical exploration in all cases in which irremovable distant metastatic growths cannot be demonstrated. When it is also considered that resection of the growth offers the only prospect of cure and that the 128 patients who lived 10 years or more following operation for cancer represent about 20 per cent of the patients for whom resection could be carried out, the curability of the disease is established.

IMPORTANCE OF NOMENCLATURE IN CANCER CLINICS¹

WILLIAM CARPENTER MacCARTY, M D, ROCHESTER, MINNESOTA

ALTHOUGH the main functions of the art of medicine are cure, palliation, and prevention of disease one of the first material necessities is a specific universal language for observational record, correlation, and communication of ideas

Since our particular interest in this conference is cancer and related conditions, among the first things we should consider is the existing nomenclature as found in medical literature, teaching, and practice I have collected from the literature of the last thirty years more than 950 terms applied to neoplastic conditions It is sufficient to state that no textbook or medical dictionary contains all of these terms This is very fortunate because many of them are meaningless and neither denote nor connote anything of cytological, histological, biological, or clinical value Although still in general use, no pathologist or group of pathologists or clinicians would use all of these terms No two authoritative textbooks have even the same small part of the whole group They must be recognized temporarily, however, because they stand in the literature and will remain there with authority until some one presents a simpler conception of neoplastic conditions and co-incidentally simplifies the terminology

The following is a list of the collected terms now being used indiscriminately in medical literature The terms are arranged under the letters of the alphabet, in the order of their frequency One glance should be sufficient to reveal the chaotic and unscientific state of pathologic nomenclature applied to neoplastic conditions

Adenoma
cysticum
sebaceum
sudoriferum
papillum
alveolare
destruens
papillare
tubulare
umbilicale
chorio destruens
cyst-mucosum

Adenoma
cyst atheromatosum
cyst papilliferum
cyst-glandulare
cyst-phylloides
cyst pseudomucinosum
cyst serosum
fibrosis
fibro papillare
fibro pericanaliculare
fibro-plexiform
fibro acinosum

Adenoma
fibro-tubulare
fibro-papilliferum
intra-canalicular
malignum
carcinomatosum
endotheliale
adamantium
(simple)
(cystic)
(papillary)
(papillary cystic)
(pseudomucinous)
(cystic pseudomucinous)
(cystic fibro)
(fibro-)
(fibro cyst-)
(fibro-pericanaliculare)
(polypoid)
(diffuse)
(tubular)
(benign)
(follicular)
(multiple)
(alveolar)
(malignant)
(malignant aleucæmic lymph-)
(cyst-)
(papillary cyst-)
(pseudomucinous cyst-)
(psammo-cyst-)
(serous cyst)
(saccular)
(chondro-)
(myxo)
(carcino)
(lymph-)
(papillary epidermal)

Angioma
simplex
simplex hypertrophicans
simplex hypertrophicans
lipomatosis renis
simplex hyperplasticum
lymph cavernosum
lymph-hypertrophicum
lymph tuberosum multi-plex
lymph-cysticum
lymph cystoides
lymph simplex
lymph-fissurale
lymph-cutis circumscripta
hæm plexiformis
hæm cavernosum
hæm hypertrophicum
hæm sarcomatodes
arteriole racemosum
arteriale racemosum
arteriale serpentinum
cavernosum
hypertrophicum

Angioma
capillare
cirrroides
racemosum
telangiectaticum
telangiectodes
phlebogene
vinosum
varicosum
fissurale
sarcomatodes
(fibro)
(lympho-)
(lymph-)
(lymph cystic)
(lymph-simple)
(cystic lymph-)
(lipo-lymph-)
(hem lymph-)
(hemato-lymph-)
(erectile lymph-)
(hæm-)
(hæm-telangiectatic)
(hæm-cavernosus)
(hæmo-)
(chyle)
(plexiform)
(pedunculated)
(telangiectatic)
(cavernous)
(senile)
(Ranken)
(chol-)
(neuropathic)
(sarcomatosus)
(capillary)
(capillary hæm)
(hyperplastic capillary)
Adamantinoma
(solid)
(cystic)
(alveolar)
(tubular)
(dentigerous)
(odontoma)
(malignant)
(corono dental)
Adenia
(aleucæmic)
Acanthoma
(adeno-)
Acrochordoma
Acervuloma
Blastoma
(tetralogenic)
(heterochthonous)
(fibro-)
(lipo-)
(epithelio-)
(erythro-)
(endothelio-)
(melano-)
(neuro-)
(myxo-)

¹Presented before the Conference on Cancer Clinics and Symposium on Cancer Clinical Congress of the American College of Surgeons, New York, October 15, 1931

Blast m —C u d

(gl)
(my l)
(lympho-)
(t)
(h m g)
(g)
(h rdo-)
(ch ist)
(ymp th)
(t rato-)
(h m gno- d th l o-)
(l my) (l my ma)
(ryth my l)
(d phyll t rato-)
(m phyll et rat)
(h m t)

C m
m t d
d rum
d m t m
m m
scrrh m
med ll
fib m
c ll d
g latun m
solum
y t cum
ylind m t m
mplex
acinos m
t
gra l m
t b l e
na
myx mat d
physalif rum
h d sa mat m
ull m
p pl m
d th l l
t l guctod
ad cyl d mat m
cy to- mpl
cysto- p plif rum
y to- p pl
cyl dro ll la sol l m
m d il l d m
solum rch m
solum med ll
solum gl boc ll la
gug toc ll l
cyl d oc ll l m
cy t cum
ylindroc ll l sol d m
(l l)
(d d)
(d ll)
(aci)
(eph l d)
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(soft)
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(med llary)
(ll d)
(desm pl t)

Carcin ma

(t)
(n m)
(diff)
(d t)
(fib)
(g l tun)
(gall t)
(gl d l)
(d rm d)
(polyp d)
(l d)
(t b l)
(t b l)
(thym)
(med ll ry)
(p pull ry)
(p d rm d)
(t pl t)
(Abkl tsch)
(y b d ll)
(y tu p pl ry)
(Sta b l ll)
(fi t ll)
(sq mou ll)
(polym rphu ll)
(m ll l)
(l g l l uod ll)
(p llary cyl d ll)
(l g l l)
(mall l l)
(h m l y g p d rm d)
(d)
(h)
(cy t)
(nb o-)
(h d o-)
(m l)
(psammo-)
(l l d o-)
(cy t d)
(mbry l d o-)
(papillary d o-)
(psc d m in d o-)
(t b l d)
(p pl ry)
(ysto- l d oc ll l)
(p pl ry t)

C

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(m f)
(od l)
(scrrh)
(ll)
(Z tt)
(papillary)
(d th hal)
(t b l sc h)
(ll d t)
(ham y weep)
(sq m ll)
os
(m l ry)

Cyst

(d mat)
(m ltl cul)
(d rm d)
(p d rm d)
(p d pap ll ry)

Cy t m

mple
gl d l
p plif rum
p pl
p d p pl
locul
m ll locul
m ltlcul p d
m m
m ll locul m
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(p ly)
(p pl ry)
(p pl ry d)

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d p plif rum
d o- p plif rum p ly
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(m l gna t lymph)
(m l gna t lymph)
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(m)

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(teo d)

Chl m

(lymph d)
(lymphat)
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C ll m

(l pom my m tod)

C m t m

C h m t

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Ca re m

Cyl d m

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Cl vu

Ch lest t m

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Dec d ma m l g n m

D rm toc l l pomatos

Desm d

D m d

(mylo-)

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l p m tod (th
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(fb o-)
(h m g t m
m lt pl)
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l p th l m
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(sq m ll)
(b sal ll)
(gua t ll)
(cy tu p pl ry)
(cyl d ll pap ll ry)
(fib o-)

Epithelioma—Continued	Fibroma	Hyperkeratosis	Leucæmia
(chorio)	(polypoid)	lacunaris	(myeloid)
(melano)	(placenta)	Hodgkin's	(myelogenous)
(neuro)	(pericanalicular)	disease	(lymphatic)
(fibro papillare)	(telangiectatic)	sarcoma	(pseudo)
(papillary fibro)	(edematous simplex)	granulomatosis	Leukoplacia
Elephantiasis	(lymphangio)	lymphoma	(linguæ) (psoriasis or
cavernosum	(neuro-)	Hypernephroma	ichthyosis)
neuromatosa	(chondro-)	(cortical)	Lympho granuloma
mollis	(cysto)	(medullary)	(Hodgkin's disease)
neurofibromatosa	(angio)	(malignant)	Lymphosarcomatosis
lymphangiectatica	(adeno)	Histiomata	Leucosarcomatosis
(fibrous)	(myxo-)	(tissue tumors)	Linitis plastica
Epuhis	(myo)	Hornkankroid	Myxoma
myomatosa	(lipo-)	Hyperostosis	simplex
fibrosa	(neuro plexiform)	Hamartoma	medullare
sarcomatosa	(plexiform neuro)	Hauthorner	gelatinosum
sarcomatosa gigante	(adeno edematodes	Hautkrebs	molluscum
cellulare	cysticum)	Hornifying canceroid	fibrosus
carcinomatosa	(adeno- edematodes)	Keratoma	telangiectaticum
carcinomatosum	(adeno myxo)	hereditarium	cavernosum
Exostosis	(chondro lipo)	Keratosis	cysticum
eburnea	(lymphangio- lipo)	Keloid	pericanalicular
medullaris	(cystic calcareous)	(cicatrix)	intracanalicular
fibrosis	(cystic adeno-)	Kavernoma	lipomatodes
cartilaginea multiplex	(cystic intracanalicular	Lipoma	sarcomatodes
(cartilaginous)	papillary adeno)	pendulum	(congenital)
Exostoses	(calcareous intracanalicu	telangiectodes	(nerve)
(periosteal)	lar adeno)	arborescens	(polypoid)
Enchondrosis	Fibromatosis	telangiectaticum	(fibro-)
(ossifying)	(angio genic)	cavernosum	(lipo)
Enchondrosis physalifera	(diffuse angio genic)	myomatodes	(glio-)
Enchondrosis ossificans	Fibrosis	ossificans	(hemangio- blasto)
Enchondroma	(adenoma)	sarcomatodes	(fibro- chondro-)
Enchondrose	Flammerepithelzysten	sarcomatosum	(pericanalicular fibro)
Entostosis	Froschleingeschwulst	lymphangiectaticum	Myoma
Eterzerknochen	Folliculoma malignum	molle	striocellulare
Ekohymoma	ovari	pendulans	levocellulare
Ephiledes	Glioma	fibrosus	levicellulare
Epidermoids	ganglionaire	durum	sarcomatodes
Epulides	molle	petrificum	malignum
Embryoma	durum	intra nephritique	lymphangiectaticum
Fibroma	ependymare	peri nephritique	angio- cavernosum
cavernosum	sarcomatodes	annulare colli	rhabdo- malignum
papillare	malignum	(angio)	leio molle
pendulum	neuro ganglionaire	(fibro-)	leio- sarcomatodes
molluscum	neuro gangliocellulare	(chondro-)	leio- malignum
pericanalicular	neuro ependymale	(pedunculated)	leio- fibrosus
intracanalicular	neuro gliomatousum	Lipomatosis	(lymphangiectatic)
proliferum	microcysticum	regionaria	(plexiform)
arborescens	ganglio- cellulare	Lipomata	(telangiectatic)
molle	telangiectaticum	(symmetrical)	(polypoid)
durum	(psammo)	Lymphoma	(cystic)
phyllodes	(myxo-)	sarcomatodes	(fibrous)
melanodes	(ependymal)	(simple)	(cavernous)
sarcomatodes	(solid)	(lymphocytic)	(leio-)
malignum	(apoplectic)	(myelocytic)	(rhabdo-)
petrificum	(medullary)	(leucæmic)	(angio-)
cysticum	(telangiectatic)	(aleucæmic)	(adeno-)
lipomatodes	(retinal)	(malignant)	(fibro-)
polyposum intracanalicu	(malignant)	(symmetrical) (Mikulicz's	(lipo-)
lare	(teratomatous)	disease)	(cystic rhabdo-)
(cavernous)	(paran)	(leucæmic) (lymphatic	(adeno- rhabdo-)
(cystic)	(paran) (chromaffine	type)	(chondro- fibro-)
(edematous)	tumor)	(lymphatic leucæmic)	(fibro- lipo-)
(plexiform)	(giant cell)	(leucæmic) (myeloid type)	(angio lipo)
(papillary)	Granuloma malignum	(myeloid leucæmic)	(malignant leio-)
(cutaneous)	Hyperkeratosis	(chloro-)	Macroglossia
(nervæ)	fungi formes	Lymphome	(lymphangiectatic)
(Ranken)	papillæ filliformes	ganglionaire anémique	(lymphangiomatous)

M er gl (h ma g m t) (h mo-lympa go- m t)	-C t d	N	v scul (go mata) chthysal rm p l p gm tos (lymph go- m t lymphangi fi broma) (fib m m l des) p gm t (el ted t l tga and phl des d g t Z gl)	P p ma (docyst) (ft) (cutan w t) (o- l t m) P th li ma m la ticum (l l) (t langect ti) (pap lary) (p pil ry) (f p) P chyd rnu m t sa q is t Pl t m Psamm m P t t m m P lgeschwul t P hyd rm t l P g t dus I hym ma phym P lym cl S m t il eo plasm cyl d m tos m t ca l l e f l l l phyll m todes myx mat d lymph m t des d th l l d th l d lymphad des ph l des t l gectali um lymphaticum t b l cyl d m p trifi t t phyll des dec d o- lul g sa m end th l des gl bo- ll t myo- tr l l l e gl bo- ll t mpl (sc rh) (ll d) (al eola) (p pil ry) (d th l l) (t langectat) (p th l d) (mel ti) (pern scul) (p th li l) (petrifying) (ossifying) (pern teal) (mixed) (eph l d) (h m rh g) (my l d) (t d) (d o-) (care o-) (d th ho-) (go-) (m l o-)	S com (h d) (psamm) (fib) () (ny) (l po-) (el) (l m o-) (h m m) (lymph g) (y to-) (myo-) (h bd) (t) (d myo-) (d o- my) (d o- y to-) (mbry l d) (go- bl t) (t b l go-) (t l g t t) (Schl h go-) (rc m d th t l) (go- my) (p n sc l go-) (pl f rm g) (p pil ry go-) (cy t p p llerum) (ryth bl t) (ch dro yst m) (h d bl st) (ch d o- myx) (ch d o- teo d) (rc h d) (t hond) (t d h d o-) (myx bl t) (myx t l l d) (t l l S myxo- m m t m) (myx l po) (g t l myx) (pern ascul my) (pl uf rm myx) (fib my) (lipo- myx) (fib bl t) (eu o- fib) (fib ost o-) (t o- fib) (p s t fib) (hl o- lympho-) (m l blast) (eu blast) (lipo- bl t) (g o- bl t) (teo- bla t) (my lo- bl t) (myo- bl t) (teo- bla t) (p ph ral teo) (my l g teo-) (t l teo) (teo-) (my l g ou) (entr l) (my l gen) (tral) (t o-) (teo- geo) (pern ost al teo-)
M l m sar m t d My l ma c matodes My l g l cemu M soth li m Neu ma ga gl o g gl d rm my lin cum my linicum sa matodes t b rcu d l l sa ga gl oc ll l rum ga gl oc ll l rum ga gl ll l (o- g gl m) (my lin) (tral) (ll l) (f l) (fibril) (ga gl) (ga gl) (my lin) (tra matu) (m l gn t) (pl d rm) (tru) (R ke) (pern ph ral) (ll l) (fib o-) (gangl o-) (p d) N ur m sarcom tod N vu sculosis p los lin ns l pom tod cul flamm s spul rru c n rven vi m rru d rum p gm tos prom en (ll l) (ca rn) (bl) (lymph) Nevi p na p m entes lymphangiectati unil t r		O teom tral p nph p gos med l d rum b rheum sa m tod sar m t um m l gnum (b) (d tal) (fib o-) (h d o-) (po gy) teom spo gos m r m d l l a Od t m (d t d) (h d) (l l) (d m t m) (t) d m t m Osteophyt P lyp (cyst) (h) (ch n) (gl d l) (H) (impl) (R h) (pl t) (t l gect u) (d m t) (angt mat) (fibro) (ca c m t u) (sar m tou) (ep th li m t us) (my m t) (m) (mixed tum) (p pil ry) (p pil ma) P lypos testin d matosa entricula P pill ma myx m todes (vascula) (m co) (sq am) (europ th)			

Sarcoma—Continued	Sarcoma	Syncytioma	Telangiectasis
(telangiectatic osteo-)	(myelogenous giant cell)	Schleim rebs	(plexiform angioma)
(malignant lympho-)	(large spindle cell)	Teratoma	Tyloma
(leio- myo)	(large cell lympho-)	embryoma	Tridermoma
(rhabdo- myo)	(round cell osteo-)	autocathones	Warze
(telangiectatic hemor-	(medullary round cell)	bigerminales	ichthyotische
rhagic alveolar)	(spindle cell) (malignant	monogerminalles	(senile)
(lymph gland)	leiomyoma)	(adenomatous)	Wart
(cylinder cell)	(hemorrhagic round cell)	(cystic)	(cutaneous)
(pigmented cell)	(large round cell)	(filial)	(pigment)
(squamous cell)	(small round cell)	(sporadic) (Adam)	(fleshy)
(giant cell)	(large oval cell)	Tumor	Wasserkrebs
(reticulo- cellulare)	Sarcome	cavernosus	Xanthoma
(reticulum cell)	angiolithic	(amyloid)	palpibrarum
(spindle cell)	Sarcomatosis	(epithelial)	diabeticorum
(mixed cell)	(lympho-)	(Kruckenburg)	multipler
(polymorphic cell)	Struma	(mixed)	multiforme
(oat cell)	lipomatodes	(nerve)	universale
(round cell)	lipomatodes aberrata	(histoid)	tuberosum
(wart spindle cell)	rens (heterotopes	(organoid)	tuberculosum
(giant cell angio-)	hypernephroma)	(cavernous)	planum
(giant cell myelogen-	ovaru	(nerve fiber)	endothelioma
ous)	Strumre	(plasma cell)	lipomatodes
(perivascular spindle	suprarenalis	(chromaffine cell)	fibroma
cell)	lipomatose suprarenali	(extramedullary plasma	fibroma lipomatodes
(small spindle cell)	Schlauchsarcoma	cell)	(vanthelasma)
(small oval cell)	(Friedrich)	(fibro plastic)	Xeroderma

In the inconvenient and impractical presence of this chaos I wish to present a simplification of nomenclature based upon a knowledge of the history of our subject its literature, and a personal first hand experience in the study of cytology, histogenesis, and clinical behavior, of more than 50,000 human neoplastic conditions which were removed surgically.

There are three great groups of neoplasms

I Those composed of adult cells with normal tissue arrangement

II Those composed of cells normally or nearly normally arranged but having a morphology of malignant regenerative cells

III Those composed of cells of the malignant regenerative type not arranged in any fashion approaching that of any normal tissue

Clinical surgical experience has taught us that neoplasms of the first group are not invasive and do not metastasize. They may interfere with the function of the organ or tissue containing them and sometimes, by their expansive growth, interfere with neighboring structures. They are spoken of as being clinically benign although they not infrequently kill their host and in this sense are sometimes just as malignant as groups II and

III In the literature, such terms as adenoma, osteoma, neuroma, myoma, and chondroma have been applied to tumors in this first group

The second and third groups embrace the so called clinically malignant tumors, the adjective "malignant" usually connoting invasion of normal tissues by the new cells and their migration to other parts of the body, thus forming metastases. From a practical standpoint there is no great clinical difference between group II and group III. Both are malignant and both kill the host. The only differences are the histological pictures and the usual greater malignancy of group III. The therapy for the two groups is the same with our present knowledge.

Identification, recognition, and consideration of these three great groups are alone sufficient for all practical clinical purposes but since there are many types of tissues in the body, each group, especially the first two, embrace tumors composed of cells which belong to and simulate histologically one or more of the different tissues. For each normal tissue type of cell there are three forms the adult or highly differentiated cells, the reparative regenerative forms, and the true neoplastic or malignant regenerative form.

Thus the first group of tumors is composed of textocytes or adult cells or their reparative regenerative forms. There are tumors of this group composed of

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glio-
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Such tumors are the textocytomas. The individual tumors may be called

GROUP I

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l po-
lymph
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my
myx

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teo-

ytom.

(b)

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C T S R

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b m
d n f rum
p pull m
l la m
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papula e
t b l
mbulcal
fibrosis
cyst m c um
cyst th m t um
cyst p pulliferum
cyst gla d l re
cyst phyllodes

Ad m
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cy t m
h no-d tru
fibro-p p l
fib p n h l
fib pl f m
fib o- m m
fib o- t b l
fib o p p l f rum
tra canabeul
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(cy t)
(p pillary)
(polypo d)
(diff)

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A E O C T I S G O C P C t n e l

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(b nagn) (h)
(f llicul) (gla dul)
(multipl) (m)
(cul) (mpl)
(l eol) (pl enta)
(cyst) (d m t)
(p d m) (p pull ry) (papul ma)
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(fib o-) (m)
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(myx) Cyt ma
(cyst fib) (poly)
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(fib p n a l l) M l
Cyt ma hyd tad sa
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gl d l (BI)
m llicul Cyst
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(d)

CH VP OCVTI SUTOR UP

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V O O T H O L T I O O O

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l eol (d ff se)
d ff m (d b)
psamum m (p l f ro)
sc l (f g d)
hyal m (lymph g)
fib m (od l)
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int rv scu l (t b)
p n ascula (l eol)
cylindromat um (cyst)
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fib d (p n scu l r)
lip m todes (xa th ma) (peri)
fib um int r f asc cu (cyst p pillary)
l (lymph essel)
lymph mat m cyl n (g)
d matodes (hem g)
(cap l ry) (lympho-)
(nscrbed) (lymph g)

ENDOTHELIOCYTIC SUBGROUP—Continued

Endothelioma— Continued (fibro-) (perivascular hemangio-)	Endothelioma (hemangio- tumerosum multiplex) Psammoma
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EPITHELIOCYTIC SUBGROUP

Epithelioma (fibro) (papillary fibro) Nevus pigmentosus prominens Nevi prominentes ichthyosiformes pigmentosus (lymphangio- mata, lymphangio fi- broma) (fibroma mela- nodes) pigmentosus (related to lentigines and ephelides according to Ziegler) Wart (cutaneous) (fleshy) (pigment) Warze ichthyotische	Warze (senile) Hyperkeratosis lacunaris fungi formes papillae filiformes Papilloma (squamous) (cutaneous wart) Leucoplakia (linguae) (psoriasis or ichthyosis) Cornu cutaneum Keratoma hereditarium Hornifying canceroid Hornkanthroid Cyst (epidermoid) Keratoma Keratosis
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FIBROCYTIC SUBGROUP

Fibroma cavernosum pendulum molluscum proliferum petrificum cysticum molle durum phyllodes melanodes lipomatodes papillare pericanaliculare intracanalicular arborescens polyposum intercanalicu- lare (cavernous) (cystic) (edematous) (plexiform) (papillary) (cutaneous) (nerv e) (Ranken) (polypoid) (placenta) (pericanalicular) (telangiectatic) (cystic calcareous) (myo) (lipo) (chondro-) (lymphangio)	Fibroma (neuro) (cysto) (angio) (adeno-) (myxo-) (adeno- myxo-) (chondro lipo-) (lymphangio- lipo) (neuro- plexiform) (plexiform neuro-) (adeno- edematodes) (adeno edematodes cysticum) (cystic adeno) (calcareous intracanalicu- lar adeno-) (cystic intracanalicular papillary adeno-) (edematous simplex) Myxoma simplex medullare gelatinosum molluscum fibrosum cavernosum cysticum telangiectaticum pericanaliculare intracanalicular lipomatodes (congenital) (nerv e) (polypoid)
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FIBROCYTIC SUBGROUP—Continued

Myxoma (fibro-) (lipo-) (fibro- chondro-) (hemangio- blasto-) (pericanalicular fibro) Pentthelioma melanoticum (alveolar) (telangiectatic) (papillary) (papillary) (of pia) Papilloma myxomatodes (vascular) (soft) Nevus verrucus verrucosus durum Epulis fibrosa	Epulis myxomatosa Desmoid (myko-) Polyp (fibrous) Epithelioma molluscum Angioma (fibro-) Fibrosis (adenoma) Keloid (cicatix) Neurinoma Polynuclear giant cell neoplasm Fibromatosis (angio genic) (diffuse angio genic) Blastoma (fibro-)
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GLIOCYTIC SUBGROUP

Glioma ganglionaire ganglio- cellulare neuro- ganglionaire neuro- gangliocellulare (psammo-)	Glioma (neuro- gliomatous microcysticum) Myxoma (glio)
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LIPOCYTIC SUBGROUP

Lipoma arborescens cavernosum molle pendulans fibrosum durum myxomatodes ossificans petrificum telangiectodes telangiectaticum lymphangiectaticum annulare colli intranephritique perinephritique (pendulum) (pedunculated)	Lipoma (angio) (fibro-) (chondro) Lipomata (symmetrical) Lipomatosis regionaria Nevus lipomatodes Angioma simplex hypertrophicans lipomatosis reus Blastoma (lipo-)
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LYMPHOCYTIC SUBGROUP

Lymphoma (simple) (lymphocytic)	Lymphoma (symmetrical) (Mikulicz's disease)
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MYOCYTIC SUBGROUP

Myoma striocellulare leucocellulare	Myoma lymphangiectaticum leucocellulare (Virchow)
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M OCYTIC US U—C tin d

O O OCYTIC US G O P—C tin d

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 (fib lipo-)
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 (ch d o-fib o-)
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O T C S U C U P

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 Ca m m
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 (g mat)
 (t l gect t)

ODONTOC II S OUP

Ad m t m
 poly ystum

Ad ma ti ma
 (sol d)

The second group of tumors (blastomas) is composed of undifferentiated or partially differentiated cells of a malignant regenerative type arranged in a fashion resembling somewhat the normal tissue arrangement. The

cells themselves differ from adult and reparative regenerative cells in that they have larger nucleoli (one or more) in granular nuclei which occupy a large part of the cell. Reparative regenerative cells are more delicate in

appearance, the nucleoli are smaller in proportion to the nucleus and the cells themselves are apt to be arranged more regularly. The component cells of the second group of tumors are a younger type, they are more primitive textoblasts—the cells from which the adult cells are normally regenerated. The tumors of this group, being composed essentially of textoblastic cells, may be called textoblastomas. One finds in this group

GROUP II

adeno- chondro- endothelio- epithelio- erythro- *	} blastomas (malignant)
fibro- glio- leuco †	
lympho- ‡	
melano- myo- myxo- neuro- odonto- osteo-	

*In pernicious anemia

†In myelogenous leucemia

‡In lymphatic leucemia lympho-sarcoma, and Hodgkin's disease

To this group belong the various adeno-carcinomas, spindle cell sarcomas, myo-sarcomas, osteosarcomas and chondrosarcomas, some of the gliomas, and many others which space does not permit mentioning

SYNONYMS FOR GROUP II (BLASTOMAS)

ADENOBLASTIC SUBGROUP

Adenoma	Carcinoma
malignum	papillosum
carcinomatousum	physaliferum
(malignant)	medullare
(carcino-)	colloides
Carcinoma	simplex
durum	evertens
adenomatousum	inertens
mucosum	tubulare
scurrhosum	varia
fibrosus	gigantocellulare
gelatinosum	myxomatodes
solidum	medullare solidum
cysticum	cyliandrocellulare solidum
cyliandromatosum	solidum globocellulare
acinosum	solidum scirrhosum
granulosum	solidum medullare
vilosum	adeno cyliandromatosum

ADENOBLASTIC SUBGROUP—Continued

Carcinoma	Cancer
cysto-papillare	(colloid)
cysto simplex	(massif)
cysto-papilliferum	(nodular)
sarcomatodes	(scurrhous)
(very cellular)	(vilous)
cyliandrocellulare micro-	(Zotten)
cysticum	(papillary)
cyliandro-cellular solidum	(tubular scirrhous)
cysto-cyliandrocellulare	(vilous duct)
(alveolar)	Sarcoma
(adenoid)	cyliandromatosum
(adult)	carcinomatodes
(acinar)	intracanalicular
(encephaloid)	phyllodes
(embryonal)	deciduo-cellulare
(Abblatsch)	(colloid)
(soft)	(alveolar)
(hard)	(papillary)
(simple)	(cylinder cell)
(scurrhous)	(adeno-)
(medullary)	(carcino-)
(colloid)	(adeno-myxo-)
(desmoplastic)	(adeno-cysto-)
(cystic)	(embryonal adeno-)
(carum)	(cysto-papilliferum)
(diffuse)	cysto-phyllodes
(duct)	Epithelioma
(fibrous)	canaliculare
(gelatinous)	intracanalicular
(Gallert)	(chorion)
(glandular)	(colloid)
(polypoid)	(endocystic)
(solid)	(cylinder cell papillary)
(tuberculous)	(chorio-)
(tubular)	(placenta)
(thymic)	(simple adenoid)
(medullary)	Struma
(papillary)	lipomatodes
(cystic papillary)	lipomatodes aberrata rens
(cylinder cell)	(heterotopes hyper-
(polymorphic cell)	nephroma)
(papillary cystic)	ovarii
(small alveolar)	Strumae
(small alveolar round cell)	suprarenalis
(large alveolar round cell)	lipomatoso supra-
(papillary cylinder cell)	renali
(Stachel cell)	Cystoma
(large alveolar)	papilliferum
(sarco-)	papillares
(chorio-)	pseudo papillare
(cysto-)	(papillary)
(fibro-)	(papillary adeno-)
(adeno-)	Polyp
(alveolar adeno-)	(carcinomatous)
(cyst- adeno-)	(sarcomatous)
(embryonal adeno-)	(epitheliomatous)
(papillary adeno-)	Hypernephroma
(pseudomucinous adeno-)	(cortical)
(tubular adeno-)	(medullary)
(papillary serous adeno-)	(malignant)
Cancer	Cytoma
nodulare	adeno-papilliferum
atrophicans	adeno-papilliferum poly-
en cuirasse	posum
(acinar)	(adeno-)
(cauliflower)	Cyst
	(pseudo-papillary)

A NO L TIC SURG OUP—C t ed

E YTH A IC SURG OUP—C t ed

Dec d m mal g m
F llic l ma m lion m

Schl chsa m
Cyl d m
Syncoyt m
Schl ml b
M th l m

Chl roma
(lymph d)
Bl t m
(ryth)
Lymph m
(chl t)

S ma
(eryth blast)
(bl lympho-)
P rn m

HOV O SHI SURG O F

F L SIC U C

S m
(h d) y t m
(h d) bl t)
(h d) myx)
(h d)

Ch d m
m l g m
m t l
C ma
h d osa m t m
(h d)

S m
myx m t d
(p sc f)
(p t l y n g)
(p th l i)
(sc h)
(t l l)
(t lum l l)
(p dl l l)
(m ll p dl l l)
(ma l l l l)
(my f g s t c l l)
(f g p dl l l)
(g a t f l my l g)
(p sc l p dl l l)
(f b)
(o-)
(myx)
(lpo)
(f b o- bl t)
(g t l l g o-)
(p r i sc l)
(myx l p)
(p r i scul myx)
(o- f b)

S coma
(eu bl l)
(g t l m y o-)
(f b my o-)
(lipo bl t)
(my blast)
(pl f r m myx)
(myxo- t l l d \ l)
l l S m y m
(lipo myx)
t cul l l t
T p l m t
r r i m t o s s
r e u m t m
m t g l a t
l l l

T O L A C O U

S m
d th l l
d th l l
t b l
y l u n d m
t l g t t m
g i s a m l th
l d
(d th l l)
(t l g t t)
(t l g t t) h m
(h a g l e o l)
(d th l)
(g)
(psamm)
(t b l g)
(t l g e c t g o-)

S m
(Schl h g i) (g i)
s a m d th l d)
(g i bl t)
(g i m y)
(t l g e c t a t myx)
S m g i l th
L d th t m
(m l g a t g)
(s a m a t h m g)
C ma
d th h l
(psamm)
Bla t m
(d th h)
(h m g i d th l)
Ca (d th h a l)
E d th l ma (my l d)

l l S m y m
(lipo myx)
t cul l l t
T p l m t
r r i m t o s s
r e u m t m
m t g l a t
l l l
F b ma
m a t d
m l u g m
N m r e m a t n d
N m s a r e m t o d
Myx m m t d
Bl t m (myx)

C O L STI OUP

n L L : S U G U

Gl m
m l l
d rum
m l u g u m
t l g e c t t m
s a r e m t o d
e p e d y m f
(p d y m l)
(p d y m)
(s o l d)
(p o p l e c t)
(m d l l r y)
(t l g e c t t)
(t n a l)
(p)

Gl m
(m l g n t)
(p r a) (h m f l)
t m)
(g a t l l)
(myx)
S m
(g l a)
(g l b l t)
Bl t m
(g l)
Cyt m
(t)
Bl t m
(p g)

I p th l m
h l l l
f l l u l a
p p l l
l b p p l l
(p p l l r y)
(y s t p p l l a r y)
(sq m l l)
(b t l l)
(g t l l)
(m t o-)
(p p l l a r y f l)
S m
(p th l d)
(m l t)
(p g m t e d l l)
(sq m l l)
(w t y p d l l l)
(m l)
(m l o- bl t)

C m
(d r m t)
(p d m d)
(h r m d y g p d r m t)
(f l a t l l)
(sq m l l)
(m l)
C
(sq m l l)
(h m y p)
Bl t m
(ep th h)
(m l a o-)
M l m
s a m a t d e s
P g t d
P l g e s c h w l t
R d t l
H t k b

L poma
m t o d

Lipoma
s a m a t m

L S T O

VTH L T S

Lymph ma
(my locyt)
(my l d l e u m)
(l m l) (my l d t y p e)

S coma
(my l g)
(my l l)
(my l l l t)

Chl m
(lymphat)

Chl m
(lymph t t y p)

MACCARTY IMPORTANCE OF NOMENCLATURE IN CANCER CLINICS

LEUCOBLASTIC SUBGROUP—Continued

Myelogenous leucemia	Leucemia (myeloid)
Cytoma (myelo) (myelo- blastoma)	(myelogenous)
Blastoma (myelo-)	Myeloma
(erythro myelo)	Myeloma sarcomatodes

LYMPHOBLASTIC SUBGROUP

Lymphoma sarcomatodes (leucemic)	Cytoma (malignant lympho)
(aleucemic)	(leuco-)
(malignant)	Blastoma (lympho)
(lymphatic leucemic)	Leucemia
(leucemic) (lymphatic type)	(lymphatic)
Lymphome	(pseudo-)
ganglionnaire anémique	Hodgkin's disease
Sarcoma	sarcoma
lymphadenoides	granulomatosis lymphoma
lymphomatodes	Lymphosarcomatosis
lymphaticum	Leucosarcomatosis
(lympho)	Lympho granuloma
(large cell lympho-)	(Hodgkin's disease)
(malignant lympho-)	Adenia (aleucemic)
(lympho- blasto)	Sarcomatosis (lympho)
Cytoma	Adenoma (malignant aleucemic lymph)
(malignant lymph)	

There is the third group composed of the malignant type of regenerative cells which are even more primitive in so far as differentiation is concerned, than those of the second group, they grow throughout the tissues and have no arrangement characteristic or suggestive of that of any normal tissue. It is a group in which it is often impossible to say whether the cells are ectoblastic, mesoblastic, or endoblastic according to the older classifications. Many such tumors have been dumped in that nondescript classification of sarcomas. I have, for years, thought of these cells as protecto- blasts and have described such tumors as protectoblastomas or problastomas. Since there is no resemblance to normal tissues there can be no prefix such as has been used for the first and second groups.

GROUP III (SYNONYMS) (PROBLASTOMAS)

Sarcoma	Sarcoma
encephaloides	(hemorrhagic)
globocellulare simplex	(lymph gland)
globocellulare	(mixed cell)
(mixed)	(polymorphic cell)
(encephaloid)	(round cell)

MYOBLASTIC SUBGROUP

Myoma	Sarcoma
sarcomatodes	(ort cell)
malignum	(spindle cell) (malignant)
leio sarcomatodes	leio- myoma)
rhabdo malignum	(myo)
leio- malignum	(rhabdo-)
(malignant leio)	(rhabdo myo)
Sarcoma	(leio- myo-)
myo- striacellular	(myo blastic)
fuso cellulare	(adeno myo)

ODONTOBLASTIC SUBGROUP

Epithelioma	Adamantinoma
adamantium cysticum	(malignant)

ANGIOBLASTIC SUBGROUP

Sarcoma	Angioma
(hemangio)	telangiectodes (pro-
(lymphangio-)	angio II)
(plexiform angio)	Carcinoma
(angio blastic)	telangiectodes
Angioma	Angioma
sarcomatodes	(sarcomatous)
hem- sarcomatodes	Angio
	tertiblastoma

Sarcoma	Sarcoma
(large round cell)	(hemorrhagic round
(small round cell)	(cysto-)
(large oval cell)	(papillary angio-)

In the literature one finds many terms which are rather nondescript, some may even be true neoplastic conditions where they belong in any classification probably always be open to contention. Wasteful discussion.

MISCELLANEOUS TERMINOLOGY

Adenoma	Blastoma
adamantium	(sympatho)
endotheliale	(terato-)
(lymph)	(disphylic terato)
(papillary epidermal)	(monophylic terato-
(psammo cyst-)	(Adami)
(sarco) (adenosarcoma)	Bidermoma
Adenia simplex	Callositas (Tyeloma)
Acanthoma (adeno)	Collonema (lipoma
Angioma (neuropathic)	myxomatodes)
Acervuloma	Chordoma
Acrochordoma	Collonema
Blastoma	Chivus
(tetralogenic)	Cholesteatoma
(heterochthonous)	Chromatophoroma
(hamarto)	Choroida oculi
(chordo)	Chonstoma
(chordoma)	

MISCELLANEOUS TERMINOLOGY—Continued

Elephant	Phyma phyma
caum	P t t m m
matosa	(k fm)
mili	P chydroma
fib mat	mat sa
lymph glect	q t
(fib)	Tum
Epithelioma	c m
()	(amyl d)
(uro-gl m t um)	(p th h f)
(g gl m t m)	(k k b g)
(g gl m l l)	(m l)
(gl mat um)	(rv)
(l m l l)	(hs t d)
Γ d th l m	(g d)
h l teat mat m	(ca m)
(ino-sa)	(ch m ff) H)
Fl hym m	(pla m c ll)
Eph lid	(t m d ll ry pl m
Ep d rm d	ll)
Ep lidea	(fb pla t)
Fschl m schw l t	(fib)
G l m m ligh m	Ty! m (call t)
H m toma	Trd rm m
H th m	W kr bs
H t m t (t tum)	Y th m
N us	p ip b rum
p losus	du b t rum
p l	m lt pl
(ll la)	m Hs rm
N	sal
pl	t b um
pl	t b los m
nas l i ns	pla m
P lyp	fib ma
(ch l)	fib ma lipom t d
(lf)	d th l m
(R h m)	lp m t d
P pill ma	(sa th lase)
(o- l t m)	Y d rma p gm t um
P chyd rmatoc l	

characteristics of the cells. At least these two terms would designate whether or not they were malignant or benign.

F L CYTOMAS

T t m	T t m
mbey m	(p rad) (Adama)
th hth	D rm d
bg m m l	Cy t (d m d)
m r m l	Lmbry m
(d m t)	Cl m (t rat m t)
(y t)	P lyp (mixed t m)
(fb l)	

For practical diagnostic prognostic and therapeutic purposes only three words are essential: cytomas, blastomas, and problastomas, provided we adhere to the definitions which have been stated. The first is benign—does not metastasize but grows expansively; the two last grow invasively and metastasize. The first group requires local removal and the second and third groups require radical removal.

Prognosis in all is dependent upon at least seventeen known factors: the type of neoplasm, the size of the growth, anatomical location, presence or absence of lymph nodal involvement and metastasis, fixation of the growth, renal and cardiac efficiency, presence or absence of anemia, age of the host, duration of the disease, direction of growth, presence or absence of loss of weight, presence or absence of cellular differentiation, lymphocytic infiltration, fibrosis and bialization, and finally upon the extent of the destruction produced by therapy.

It seems reasonable to consider all dermoids and teratomas as polycytomas or polyblastomas depending upon the morphological

NEWER DEVELOPMENTS IN X-RAY THERAPY OF CANCER¹

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THE expression "deep roentgen therapy" means to most of us the treatment almost exclusively of neoplasms. Probably not more than 15 per cent of the so called deep roentgen-ray treatments are given for other diseases. To name the processes in which deep roentgen-ray therapy seems indicated, and has been or is being employed, would be to enumerate practically all of the benign or malignant neoplastic processes, and the allied diseases. This great group accounts for probably 80 to 90 per cent of all deep roentgen-ray treatments, the remaining 10 to 20 per cent consisting, of course, in the treatment of a variety of inflammatory processes and glandular diseases.

However, it is quite true, that the use of the roentgen-ray has been extended with notable advancement in this latter field, during the last few years, and it appears that a new chapter on the effect of various amounts of the roentgen-rays on deranged or altered gland function has been opened.

Roentgenologists and others who have had an opportunity of observing the effect of various doses of roentgen-rays on certain ductless glands are impressed with the definite and often quite startling changes produced, and without much play of the imagination, visualize a wider and more scientific application of roentgen-rays for the numerous conditions directly and indirectly resulting from derangements of the endocrine system.

The extent to which the abuses of roentgen-rays occur in this field, as also in the treatment of neoplasms, is difficult to estimate. The dangers of irreparable damage being done in its use for the stimulation or depression of ovarian, thyroid, and other gland function, and in its uncontrolled application to produce abortions, and in its use in goiters and uterine myofibromata in young adults, not to mention numerous other conditions, should be kept in mind constantly by those responsible for the exposures. The need for greater care in its use in this field than in that of cancer is obvious.

It is believed, however, that the surface has been barely scratched in the application of roentgen-rays in the treatment of acute and chronic inflammations and diseases associated with derangement of ductless glands.

To those roentgenologists who have had an opportunity of following and examining the same patients over a period of many years following roentgen-ray therapy, there comes an appreciation of the late or remote roentgen-ray effects, and the various manifestations of irradiation, some of which are confused with other disease processes, and a conservative rational attitude toward roentgen-rays and their usefulness in the treatment of disease, which is lacking in the surgeon or internist whose observations are more limited and casual.

It should not be concluded, however, that the views of roentgenologists regarding the value and limitations of roentgen-ray therapy have crystallized, or that they believe it has come to occupy a definite or limited position in physical therapy, or that standardized methods of administering doses except in a very few diseases have been adopted to date. It is obvious that as the nature and etiology of cancer remains obscure, many theories will be advanced in support of the different methods and dosages employed in the treatment of this great variety of diseases. Hardly a year passes without a new technique or method of administering a dose of roentgen-ray being advocated in the treatment of cancer.

We have the fractionated dose method, i.e., small doses of heavily filtered high voltage roentgen-rays given frequently over a long period of time. By this method three or four times as much radiation can be given to the tumor without immediate evidence of damage to the skin as may be administered at a single exposure. The critics of this method state that although it is true that the skin stands this treatment very well, so does the cancer. In France and elsewhere Regaud's theory of "mother and daughter cells" is used in support of

¹Presented in the Cancer Symposium, Clinical Congress of the American College of Surgeons, New York, October 13, 1931.

talis will be on the heart and pulse rate. The roentgenologist knows what the effect of a certain exposure to the roentgen-ray will be on the skin and subcutaneous tissues. He knows also that in general, carcinomata are more resistant than sarcomata, but that many exceptions occur in both groups. Cellular, vascular, embryonal tumors, those most malignant from the histological view are most radiosensitive, while avascular tumors composed of adult types of cells, with much connective tissue stroma are generally resistant.

But it frequently happens that the roentgenologist is not supplied with a description of the gross anatomy or histological structure of the tumor, and when this information is lacking and unobtainable, as so often happens, and when it is impossible to determine the vascularity of a tumor and the amount of connective tissue stroma or the character and variety of numerous cellular elements, the radiologist must rely on test doses to determine the degree of radiosensitivity. Heavy doses given to sensitive vascular tumors have been followed by a rapid breaking down of the tumor with death of the patient resulting from toxæmia and hæmorrhage.

I had intended to devote some space to technique, with diagrams showing methods of delivering definite quantities to tumors situated deep in the abdomen or pelvis, and also to discuss the statistics giving results of the roentgen-ray treatment of various groups of tumors. On second thought, however, I decided that the technical or physical side of roentgen-ray therapy would interest only radiologists, and as for statistics, I share the belief with others that they frequently, in cancer work, demonstrate more the lack of knowledge of the disease which exists than our skill in its treatment.

That the surgeon may visualize clearly the present status of deep roentgen-ray therapy, reliable statistics are sought, and would be of inestimable value, but it must be confessed that the statistics which deal with the results of deep roentgen-ray therapy only are not extremely few in number, but in most instances are found to be, on close scrutiny and careful analysis, of but little value. The only statistics of value are those showing results where

deep roentgen-ray therapy has been employed along with, or as an adjunct to, radium or surgery, or both. Furthermore, the only statistics comparing irradiation results with straight surgical results in primary operable tumors deal with carcinoma of the cervix uteri, most of which show the superiority of radium combined with roentgen-ray over surgery.

Those of us who repeatedly see immediate and remote effects of the roentgen-ray on certain types of inoperable and inaccessible tumors find it difficult to restrain our impatience with the delay with which irradiation therapy is accepted as the method of choice in the treatment of certain groups of so called primary operable tumors.

That there is sufficient evidence in the roentgen-ray clinics throughout the country to indicate the superiority of radiation therapy in the treatment of certain groups of tumors is indicated by the case reports which appear in the literature from time to time, and I believe that funds should be obtained by the American Roentgen Ray Society and the American College of Surgeons for the purpose of collecting such data, with the object of having available in time sufficient information from which authentic and reliable statistical reports could be prepared for publication. The American College of Surgeons through the Registry for Bone Tumors has accomplished a piece of educational work which should be a stimulus for similar undertakings along corresponding lines in other fields.

However I would like to emphasize the fact which is commonly accepted, regardless of the chaotic state in which the question of selection of dosage appears to be, and the lack of reliable statistics, that in the treatment of primary inoperable carcinoma, recurrences and metastases, no other agent so universally at our disposal offers the degree of palliation obtained through the judicious use of X-rays. The degree of palliation often is difficult to determine and an opinion can be formed only by a comparison of the patient's condition before and after treatments often months after, and a thorough knowledge of the character and extent of the process in each given case.

In the treatment of primary operable carcinoma internists and surgeons who have had

an opportunity of comparing the results obtained through the use of radium or roentgen rays alone or combined with surgery now look upon these agents as occupying a definite and indispensable place. Some radiologists and surgeons like to employ radium for its local destructive effect on the tumor and surgery later to remove necrotic tissue. Deep roentgen ray therapy to the tumor surrounding tissue and lymphatic areas now so frequently precedes and follows this procedure that it appears that those responsible for its use are convinced that the percentage of cures thereby is very definitely increased.

Any advance lately achieved in deep roentgen ray therapy would hardly have been possible without the co-operation of the manufacturers of the modern X-ray machines and tubes under the leadership of such scientists as Coolidge. Great credit must also be given to physicists such as Sheerer whose untimely death resulted in the loss of one who was looked upon as the leader of this group of non-medical workers whose contributions have been of such great value. Their efforts are largely responsible not only for numerous improvements in apparatus measuring instruments and technique of treatment but for finally standardizing a method of determining a unit of dosage expressed in terms which mean regardless of apparatus and tubes a definite known quantity. Through the efforts of Failla and other physicists and committees of the roentgen ray societies the Bureau of Standard at Washington is able to furnish all roentgen ray laboratories with the details and specifications required for measuring X-radiation in order to obtain what has been internationally accepted as an amount of radiation designated as the R unit.

But of all those whose help has been of most value that of a pathologist Ewing stands out prominently. Through his observations on the action of radiation on tumors the medical profession has had its attention directed repeatedly through numerous publications and lecture to the possibility of the benefits to be obtained through its use in the treatment of cancer and it is believed that no other single individual has done as much to aid in the advancement of deep roentgen ray therapy.

But in spite of the help available and the knowledge accumulated it must be confessed that even among those regarded as authorities there is still great divergence of views concerning the best method of employing an agent capable of doing so much good or so much damage. Some of the reasons for this appear to be that frequently those who know most about cancer know least about physics while those who appear to have a profound knowledge of physics have only an elementary knowledge of neoplastic diseases. Now that it is possible to deliver quite accurately a definite quantity of roentgen ray to a tumor and its surroundings regardless of depth and location and since there is no longer any uncertainty regarding the amount of radiation absorbed by the skin and each succeeding centimeter of tissue beneath it some roentgenologists who appear to be better physicists than physicians are constantly in search of a fixed dose for certain groups of tumors. There is not and probably never will be a standardized carcinoma dose. It may be that some time in the future there will be available some sort of a biological index or guide for the radiologist in the selection of a certain dose but there is no indication now that such a hope will be realized.

The tangible evidence of the present status of deep roentgen ray therapy through which comparison may be made with the past lies in the development of machines, tubes and instruments for accurately measuring their output and the definition of a fixed quantity of radiation known as the R unit with a consequent improvement in the technique of administering the dose selected. The latest development in the field is the installation of an apparatus at the Memorial Hospital capable of producing X-rays at a voltage close to 1,000,000.

To hold the view or express the opinion that nothing new in radiation effects can be expected through the application of X-rays produced by such an apparatus on the basis that through the use of more penetrating rays of shorter wave length than the γ rays of radium clinicians and pathologists have been familiar for years with the changes and effects resulting therefrom would be unsound and illogical cause of the differences in intensity

of the radiation dose possible with such high voltages. Although the radiation produced with such a machine is not as penetrating as the γ -rays of radium, it is considerably more penetrating than radiation produced at 200,000 volts. There is little doubt that the effects of radiation vary with the intensity of the dose. A dose given in 3 days would hardly be expected to produce the effects obtained by the same dose given in 3 hours or in 30 minutes. With this machine it is possible to give a dose in 45 minutes, which with a 4 gram radium element pack requires many hours.

However, to conclude, the success or failure of deep roentgen-ray therapy in each case should be ascribed not so much to the specific action of roentgen-rays as to the judgment exercised by the radiologist in selection of the dose and method of administering it. It is obvious that this judgment results from the knowledge possessed concerning the disease in each patient and the effect of certain doses on such processes, which is obtained largely as a result of experience and through which comes a realization of one's own limitations and the limitations of deep roentgen-ray therapy.

THE NEWER OUTLOOK UPON CHRONIC ARTHRITIS¹

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THE subject of arthritis is one which, in some of its phases, is of interest not only to the internist but to surgeons as well and especially to orthopedic surgeons.

I do not know whether you are aware of the extent to which general interest in arthritis has grown. Statistics show that it is the disease constituting the greatest sociologic burden which society bears, even surpassing tuberculosis, but only recently has the public, lay and medical, become cognizant of this fact. Much remains to be done in the way of arousing adequate recognition of the problem of arthritis but it is fair to say that never heretofore has so much attention and effort been directed to it as at the present time.

There are two chief reasons why interest in this subject has grown apace. The first is the demands of insurance agencies that something be done about the ravages from arthritis; the second is the wider angled studies of arthritis, recently going forward, which reveal that the disease is not only of surpassing interest but one for which a great deal can be done. Treatment of arthritics in the past has had to do almost exclusively with the particular lines of training and interest of the given observer and it is not surprising therefore that the results of therapy have been so

often disappointing. In order to place before you the light in which the American Committee for the Control of Rheumatism views chronic arthritis, let me here cite briefly part of its concept as to the general nature of this protean disease.

"The Committee conceives of the disease as a generalized disease with joint manifestations. Certain prodromes may be recognized and it is of vital importance that they be recognized. It is the opinion of the Committee that at the present time no single infectious agent or completely defined dietary deficiency or metabolic disorder has been conclusively shown to be the sole cause of these disorders. The Committee inclines to the belief that any one of these factors, or certain combinations of these factors, under appropriate circumstances, may basically underlie the onset of the disease."

I think it important to tell you thus of the views of others who have studied this problem closely, so that you will not feel, that in what I have to say, I am expressing radical opinions and conclusions of my own.

Let me add at this point that in addition to the interest now being aroused in arthritis an increasing amount of interest is also being aroused toward the physiology of bone. As

¹Presented before the Clinical Congress of the American College of Surgeons, New York, October 1-16, 1931.

an opportunity of comparing the results obtained through the use of radium or roentgen rays alone or combined with surgery now look upon these agents as occupying a definite and indispensable place. Some radiologists and surgeons like to employ radium for its local destructive effect on the tumor and surgery later to remove necrotic tissue. Deep roentgen ray therapy to the tumor surrounding tissue and lymphatic areas now so frequently precedes and follows this procedure that it appears that those responsible for its use are convinced that the percentage of cures thereby is very definitely increased.

Any advance lately achieved in deep roentgen ray therapy would hardly have been possible without the co-operation of the manufacturers of the modern X-ray machines and tubes under the leadership of such scientists as Coolidge. Great credit must also be given to physicists such as Sheerer whose untimely death resulted in the loss of one who was looked upon as the leader of this group of non-medical workers whose contributions have been of such great value. Their efforts are largely responsible not only for numerous improvements in apparatus measuring instruments and technique of treatment but for finally standardizing a method of determining a unit of dosage expressed in terms which mean regardless of apparatus and tubes a definite known quantity. Through the efforts of Failla and other physicists and committees of the roentgen ray societies the Bureau of Standard at Washington is able to furnish all roentgen ray laboratories with the details and specifications required for measuring X-radiation in order to obtain what has been internationally accepted as an amount of radiation designated as the R unit.

But of all those whose help has been of most value that of a pathologist stands out prominently. Through his observations on the action of radiation on tumors the medical profession has had its attention directed repeatedly through numerous publications and lectures to the possibility of the benefits to be obtained through its use in the treatment of cancer and it is believed that no other single individual has done as much to aid in the advancement of deep roentgen ray therapy.

But in spite of the help available and the knowledge accumulated it must be confessed that even among those regarded as authorities there is still great divergence of views concerning the best method of employing an agent capable of doing so much good or so much damage. Some of the reasons for this appear to be that frequently those who know most about cancer know least about physics while those who appear to have a profound knowledge of physics have only an elementary knowledge of neoplastic diseases. Now that it is possible to deliver quite accurately a definite quantity of roentgen ray to a tumor and its surroundings regardless of depth and location and since there is no longer any uncertainty regarding the amount of radiation absorbed by the skin and each succeeding centimeter of tissue beneath it some roentgenologists who appear to be better physicists than physicians are constantly in search of a fixed dose for certain groups of tumors. There is not and probably never will be a standardized carcinoma dose. It may be that some time in the future there will be available some sort of a biological index or guide for the radiologist in the selection of a certain dose but there is no indication now that such a hope will be realized.

The tangible evidence of the present status of deep roentgen ray therapy through which comparison may be made with the past lie in the development of machines, tubes and instruments for accurately measuring their output and the definition of a fixed quantity of radiation known as the R unit with a consequent improvement in the technique of administering the dose selected. The latest development in the field is the installation of an apparatus at the Memorial Hospital capable of producing X-rays at a voltage close to 000,000.

To hold the view or express the opinion that nothing new in radiation effects can be expected through the application of X-rays produced by such an apparatus on the basis that through the use of more penetrating rays of shorter wave length that is the γ rays of radium clinicians and pathologists have been familiar for years with the changes and effects resulting therefrom would be unsound and ill-logical. One of the differences in intensity

ology, that is to say, the deviations of physiology which are responsible for the actual phenomena of the disease. The interesting chain which investigative work has welded cannot be given in detail. Suffice it that an important fundamental feature of this dynamic pathology is revealed in the fact that arthritics at the periphery show a temperature which runs from 2 to 3 degrees centigrade lower as measured by the thermocouple, than it does in normal persons. The cold hands and feet of arthritics have long been recognized, but the true explanation is only now forthcoming. Exposure of arthritics to environmental cold shows that whereas the initial peripheral temperature is lower, the subsequent fall of temperature is also less. Upon the return of the subject to room temperature, the rise of the lowered peripheral temperature is also slower and less than with normals. This constitutes a condition approaching rigidity of the finer vascular system of the periphery because it is known that, other things being equal, the temperature in a part is a function of the blood flow through it. Again, direct observation of the capillaries under the microscope shows them to be more or less closed, or at least empty, in the arthritic. Measures which benefit the patient subjectively, such as heat, massage, exercise, coffee, aspirin, and the like, are seen to open up these capillary beds and to induce a blood flow approximating normality. Again, if the red cell count of the periphery be meticulously observed, there will be found a difference, namely, a lowered count, in the blood first issuing as compared with later issuing blood. This is the reverse of the normal relationship. It thus appears that the rheumatoid syndrome is accompanied by a disturbance of peripheral blood flow in the finer vessels suggestive of vasoconstriction. It should, therefore, be possible to induce something of the phenomena of arthritis by experimental interference with the blood flow in laboratory animals. This has, indeed, proved to be the case and by ligating the vessels of the patella in dogs, marked bony overgrowth can be induced in periods varying from 4 to 9 months, as the work of Wollenberg and of the writer and his associates has shown. Attention should

also be called to the influence of sympathectomy, as advocated by the Mayo Clinic, for a small number of cases. This further illustrates the involvement of the nervous system in production of the disease, already recognized in the Charcot joints of tabes and syringomyelia.

Attention must now be turned to another series of observations bearing at once on etiology, pathology, and therapy. The writer has recognized for many years the relation of certain gastro-intestinal deviations, as determined by the X-ray as well as the importance of dietetics to many cases of the arthritic syndrome. Recent work of Rowlands and others has shown that these gastro-intestinal deviations can be closely simulated in dogs fed upon a certain ration low in vitamin B and accompanied by a large intake of carbohydrate. Furthermore, these deviations return toward normal with correction of the dietary. These abnormalities exist equally in both types of arthritis among humans, and Fletcher has recently shown that with correction of the dietary the abnormal X-ray picture in them returns toward or to normal, precisely as it does in experimental animals. The deviations in the gastro-intestinal tract are in the direction of elongation, dilatation, reduplication of the bowel, achlorhydria, lethargy of the gall bladder, and even general visceroptosis. In this situation can be seen some of the influence of faulty body posture which, itself, induces or permits mal-position of the thoracic and abdominal viscera. Faulty body posture also results from such mal position and so contributes to a vicious cycle. There is here obviously a series of observations whose philosophic and therapeutic implications are far reaching. It may be said that the hitherto current, and sometimes narrow, conception of the etiology of arthritis becomes merged in a wider outlook of significance basal not only to arthritis but to many associated conditions as well, e g., to dogmatize as to the exclusive domination of focal infection in this field, in the ordinary sense of the word, is to fail to see the problem whole and, above all, to fail to bring to bear proper therapy.

Observations complementary to the aforementioned lines of reasoning are to be seen,

surgeons you have long given constructive thought to the osseous system of the body but medical men at large and perhaps internists in particular have too long regarded the bony skeleton as only a rack on which to hang a few aids to locomotion and even an occasional cloak of ignorance. Modern appreciation of the role played by the osseous system emphasizes the fact that this tissue is concerned in fundamental processes of the economy, namely the blood forming activities and calcium metabolism and that the one in turn are conditioned by the anatomical, physiological and pathological relationships of the particular bones concerned. It seems to me important to stress this point because the questions of bony pathology and calcium metabolism are intimately tied up with the problem of arthritis. Appreciation of the importance of the osseous system makes it easier to understand the necessity for an open minded approach to the broad problem of rheumatoid disability.

In the limited time at my disposal there will be opportunity to review only hastily some of the essential lines of reasoning which determine our present concept of the disease and the therapy secondary to it. One of the interesting facts which recent studies have brought out is the marked influence of heredity in the production of arthritis. This does not mean that the disease is inherited *per se* but it does mean that the background upon which the disease is implanted is definitely inherited in about 50 per cent of all cases. On the basis of this it is not difficult to understand the emphasis which the Boston orthopedists particularly Osgood have placed upon the significance of body build in predisposing certain individuals to various arthritis. As will appear later it is pretty clear that the nervous system is definitely caught up in the mechanism of the disease and it is therefore not surprising to find that fatigue is a factor in etiology and by the same token rest becomes a factor in recovery. This equation has long failed of adequate recognition. Enough has been said perhaps to suggest that the etiology of arthritis is thus varied and not dependent upon one factor such as focal infection alone. Emphasis has properly been placed upon focal infection in the production

of many forms of disease but it is also plain that its influence has often been overstated and that in any event one must look for the soil and conditions on and under which it becomes operative. The world is peopled with persons harboring abscessed teeth who have neither arthritis nor other demonstrable malady. The influence of infections of various kinds however is very clear cut in precipitating a certain proportion of cases of arthritis. Many organisms can initiate the disease but it is probable that the streptococcus is the most frequent offender though no single strain preempts as yet the chief rôle in the cases which are of infectious etiology.

It is necessary at this point to stress the fact that the American Committee for the Control of Rheumatism recognizes two chief varieties of arthritis namely atrophic and hypertrophic. The former affects people at or below mid life and is characterized by destruction of the joint cartilage by overgrowth of a synovial pannus together with a form of granulation tissue springing from the shaft which destroys the joint cartilage equally from below. The pannus leads to adhesions these lead to limited motion and the granulation tissue between the adjacent bones leads to bony ankylosis. The second great variety is hypertrophic arthritis affecting people mostly beyond mid life and characterized primarily by a degeneration of the joint cartilage which leaves the bony ends exposed leading to the high polish from friction of them known as eburnation. True bony union rarely takes place in this type. There is however overgrowth of bone at the margins of the joint and the trabeculae of the shaft and head undergo at the same time a decalcification which leads to deformities from weight bearing and pressure.

Both types of arthritis however are definitely systemic in nature and the bony tissues are often caught up only incidentally to the march of the disease as a whole. Many persons who suffer great invalidism from the arthritic syndrome have nevertheless very little true arthritis.

A significant recent advance in our understanding of arthritis springs from an increasing knowledge of the so called dynamic path

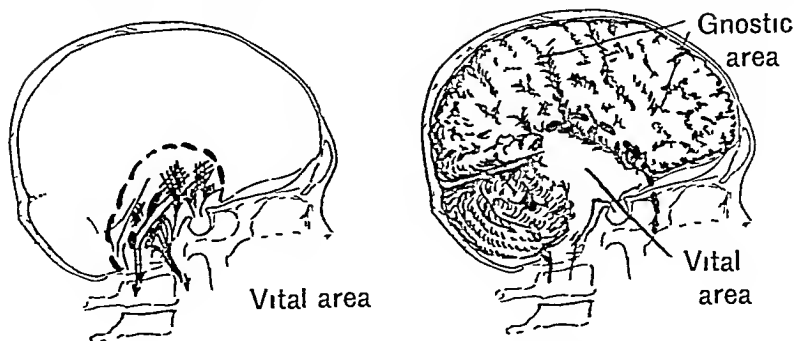


Fig 1 Division of the brain into (a) vital and (b) gnostic areas. The vital areas are concerned during the immediate post-traumatic phase. The gnostic areas not essential to life, but of great importance to economic readjustment. Injuries to the former, fatal, to the latter, leave evidence of mental and physical disability.

to supply adequate oxygen, and in this circumstance the "gnostic" areas suffer primarily and most severely, not only because they are at the moment least important, but because they receive five times the blood supply of the basal cells and are exposed to surface compression, and are consequently more sensitive to proportionate diminution in circulating blood volume (oxygen).

As the skull determines the limitation of intracranial volume, and as there can be no increase in volume by any of the components contained therein without an equal withdrawal of one of the factors, the problem of treatment of intracranial injuries resolves itself into attempts to maintain optimal circulation by subtracting from the cranial contents a certain volume of the least important components.

Thus, if we consider a fixed volume container, such as the skull, filled by three distinct volume components (Fig 2)—(a) arterial and venous blood, (b) nervous cellular tissue and meninges, and (c) fluid—cerebrospinal, interstitial, and intracellular—it is evident that if we increase the fluid volume component in the form of oedema, there must be a similar decrease in blood volume, and vice versa, because the two fluid components are incompressible, and the fixed container unyielding. When it is not possible to establish compensation between the two fluid components over a period of time there arises the yielding of the third volume mass, i.e., the nervous tissue (atrophy), so that eventually

although the normal ratio of the three components has definitely shifted, the total volume relationships remain the same.

In terms of clinical experience, this means, for instance, that a subdural hæmorrhage introduces a new tumor mass, and, if it occurs rapidly, displaces first the excessive venous blood, as the mass volume increases. When this compensatory factor has been completely expressed to its physiological limit, cerebrospinal fluid is likewise eliminated, as the mass volume of the hæmatoma increases pressing the brain before it and finding no resistance. Spinal pressure is not elevated because there has been an equal subtraction for the volume of the tumor introduced. Cerebral function has not been interrupted because the relationships favorable to ample circulation still maintain, so long as volume displacements are adequate. This is well recognized in the clinical picture of a sudden blow, with transient unconsciousness followed by a lucid interval and later a return to the unconscious state. The return of the unconscious state indicates a deficiency in cerebral circulation because the limits of compensation have been passed, and consequently the fresh arterial blood volume begins to be diminished in the finer capillaries of the cortex in the presence of the expanding tumor mass. With the reduction in capillary circulation, there is a suspension of cortical function and the resultant anoxæmia now gives rise to a rapid tissue oedema.

The same clinical analogy may be given for tumors of the brain, although they are slower

as already remarked in the newer studies relating to the field of physical therapy. Explanation of the value of massage, heat and exercise appreciated by arthritics for thousands of years is to be seen in the influence which these exert upon the vascular bed. The corollary is of course equally that a disturbance of this vascular bed constitutes part of the physiological deviation in arthritis.

Arthritis thus becomes therefore a wide syndrome dependent upon deviations of physiology expressing themselves in many or all tissues of the body, these dependent in turn upon a large number of prodromal and precipitating influences. To expect to influence this varied syndrome by any one measure of therapy, be it operative, physiotherapeutic, a drug or a vaccine must appear unphilosophical and clinically inadequate to any dispassionate observer. It should be obvious almost by definition that only an analysis of various subtending these component factors can be expected to influence the situation as a whole in any large series of cases. This is indeed the fact and it is primarily the purpose of the American Committee for the Control of Rheumatism to endeavor to educate the profession as a whole to the importance of this outlook.

There is of course no opportunity here to enter into the details of the many factors contributing to the intelligent therapy of arthritis. Such therapy depend upon visualization of the hereditary background, the frequently faulty posture, the usually fatigued subject, the precipitating or aggravating influences of localized infections, the almost indefinite opportunities for toxemia from the gastrointestinal tract, the particular disturbances of the soft tissues in the way of anoxemia, the correction of these by means of intelligent physical therapy, the institution of a proper dietary, and of better function of the various parts of the gastrointestinal tract as a whole.

A balanced dietary in which the vitamins are high and the calories are yielded largely by fat and by protein is probably desirable in nearly all arthritics. In properly selected cases it becomes necessary to curtail the whole caloric intake in addition and to curtail the energy output proportionately by rest in

bed. Postural rehabilitation becomes of great importance and the distressing deformities which the profession has too often permitted are no longer to be excused.

The approach to the treatment of each type of arthritis is in the minds of many observers much the same with the exception of the fact that in individual under mid life who are mostly of the atrophic type infection may cause greater systemic damage. Infection is apparently also operative though better resisted in the older subjects of arthritis by hypertrophic in type and may not then require such surgical radicalism. There are other minor differences which there is not time to restate but one leading therapeutic corollary to division of arthritics into two great groups is the fact that in the atrophic variety some motion by the subject of the part involved is useful to delay or prevent the bony ankylosis which otherwise may arise. Rest to a hypertrophic joint can be indulged more freely. Rest to the individual as a whole however is essential in both types in a high proportion of cases and often constitutes the *sine qua non* upon which every other form of therapy must depend.

There is nothing in these remarks to justify neglect of the important influence of focal infections of all kinds. The situation is rather one in which the influence of these factors is seen to be only part of the problem and often secondary to it. Indeed it is clear that focal infection often arises in consequence of the deviations in the physiology of the tissues referred to by virtue of which they become easily invaded by bacteria. Focal infection which thus arises may then of course become a cause as well as a result. In suitably studied cases vaccine therapy may be appropriate and necessary but in fairness to arthritics it should be given only the emphasis it deserves. Too many lucrative practices have been built up upon the supposed specificity of organic A or B toward the varied syndrome which suffering arthritics present. By the same token no drugs deserve to be stressed as a solution of this problem. If any are to be mentioned let them be arsenic for its influence upon the secondary anemia so commonly encountered and the salicylates to meet emergencies only.

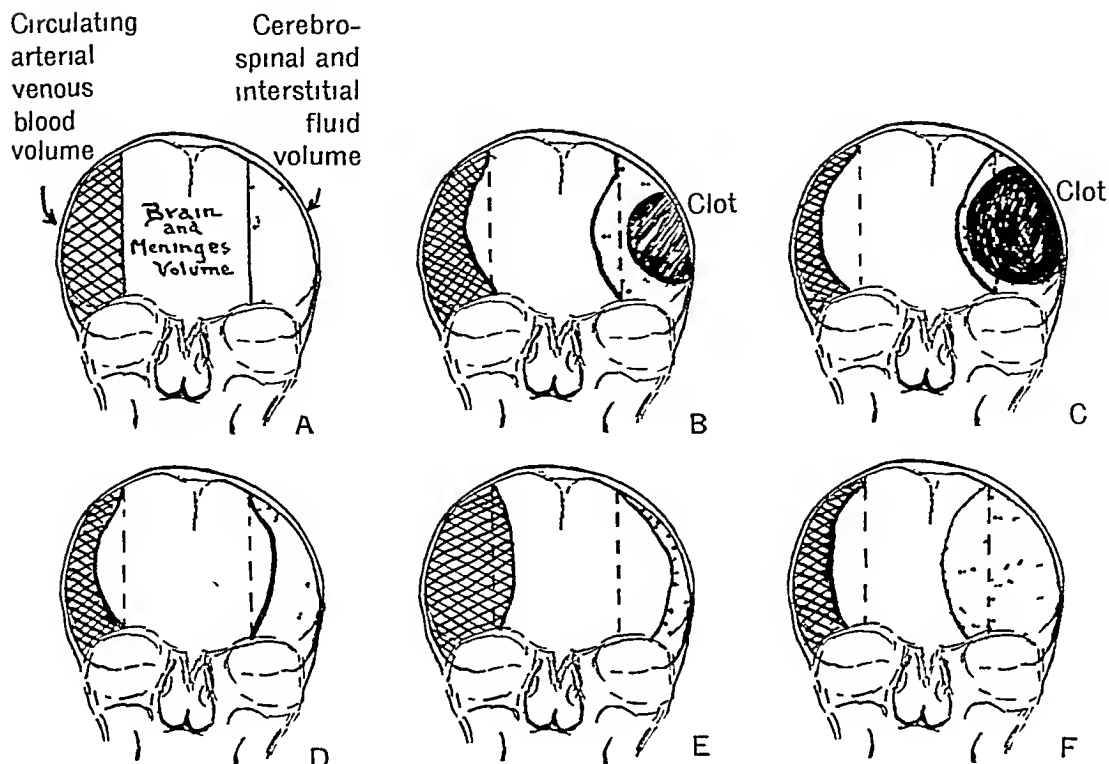


Fig 2 Diagrammatic representation of volume relationships within the skull with varying displacements of component volumes in certain types of cerebral trauma. The clinical symptoms are based upon compensation or decompensation between the component volume relationships. The importance of reducing the cerebrospinal fluid component is evident, in order to preserve the vascular and

brain volumes, which determine function and the survival of the brain tissue.

A, normal, B, compensated volume displacement, C, decompensation with compression anaemia, D, cerebral oedema with compression anaemia, E, cerebral hyperaemia with oedema, increased intracranial pressure, F, cerebral atrophy, chronic increased intracranial pressure.

be controlled by any method now at our disposal.

Surgical decompression has been afforded these cases only as a measure of last resort, but has failed in every case to benefit the patient. In other words, decompression has not succeeded where dehydration failed, and the mortality from decompression in this series is one hundred per cent. Early decompression is an unjustified procedure in cases of cerebral trauma, in my opinion. The surgeon only adds insult to injury, and does not accomplish as thoroughly as by dehydration the object for which the decompression was designed. Cerebral hernia, massive haemorrhage, and further lacerations of the brain are almost constantly produced where surgical decompressions are

undertaken in the presence of increased intracranial pressure. In the past the surgeon has escaped the criticism he merits because of the unquestioned acceptance by the profession and the laity of the statement that the patient died "of a fracture of the skull." However, our experience clearly indicates that early decompression accomplishes nothing that dehydration cannot better effect, and only greatly endangers the patient's critical condition by further cerebral trauma. The decompression here alluded to is the commonly accepted pernicious subtemporal decompression, or decompression over the site of the fracture. It is not to be confused with the orderly and intelligent exploration of the brain if the signs of an epidural or subdural hema-

in growth. The final compression symptoms are identical and the volume relationships similarly disturbed so that unconsciousness finally occurs if relief is not at hand. In the same way cerebrospinal fluid volume increases in the form of excessive spinal fluid or actual intracellular edema thus disturbing the circulatory ratio and giving rise to the more abrupt clinical picture of stupor. When both vascular engorgement and cerebral edema occur simultaneously intracranial pressure rises and we recognize the profound stupor and serious involvement of both the vital and gnostic areas. This is the most frequent type of reaction in cerebral injuries especially when a blow has been sufficiently severe to produce a fracture of the skull with concussion and contusion of the brain. In the early stages of cerebral trauma and compression the cortical capillary bed yields first to this process giving a state of stupor or unconsciousness which persists until adequate circulation is restored.

The vital centers at the base of the brain are well protected by solid masses of white matter and receive their blood supply directly from the basilar artery and the circle of Willis and their capillary network is not exposed to the surface compression which occurs over the cortex during period of generalized pressure. However as the process of edema begins in the cortical layers of the brain a swelling in the brain volume occurs with rapid continuation of the edema into the basilar areas. Thus the terminal picture is usually one of vasomotor failure associated with respiratory irregularity and as oxygen becomes less available to the brain due to a failing circulatory pressure and paralysis of the vasomotor mechanism the respiratory center fails and leaves the intrinsic mechanism of the heart to beat on for a few moments after all other neurologic activity has ceased.

If we are to accomplish not only a protection of the vital centers but an early reestablishment of cortical circulation to protect the gnostic areas the treatment must be vigorously directed toward complete control of the cerebral volume relationship and the patient must not be permitted to remain in an unconscious state if it is possible to prevent it. This means that the clinician must continue

the method of treatment not only to the satisfaction of the vital centers but must aim toward sufficient return of circulation to permit cortical function as soon as possible following the injury.

Fortunately the methods now at hand have not only yielded a marked reduction in mortality but have been attended by a prompt return to consciousness (1 a b). Of greatest importance has been the rapid economic readjustment where formerly convalescence was slow and the economic readjustment delayed or entirely impossible.

The method of treatment may be summarized in the statement that every means of subtracting fluid volume from the cranial cavity has been employed from the earliest possible moment. Fifty cubic centimeters of 50 per cent glucose is immediately given to the patient intravenously. This aids in the subtraction of cerebrospinal fluid and the intracellular fluid of the brain prevents temporarily further edema and counteracts shock by increasing blood volume with resultant improvement in blood pressure. Complete spinal drainage follows to allow further space for the necessary blood volume and is repeated in 4 to 6 hours if necessary. This entails the withdrawal of from 45 to 100 cubic centimeters of clear or bloody spinal fluid as the case may be. Magnesium sulphate or other hydragogues are given by mouth or rectum to withdraw fluid from the blood stream through the intestinal tract as soon as the shock period is over. Fluid intake of the patient is restricted to from 20 to 30 total ounces of liquid per day for the first 10 days and the patient is maintained after discharge from the hospital on a fluid level of 32 ounces for a period of 3 months. Thus the factors of edema and fluid volume are restricted to permit the optimal volume of blood circulation oxygen content and the preservation of cerebral tissue and function in the absence of compression. The case which have not yielded to this method of treatment have been few and have offered insurmountable problems such as intramedullary hemorrhage in the neighborhood of the vital centers especially the pons or cerebral contusions so extensive that the intracellular edema of the brain could not

patients have shown rapid improvement following cerebral injury and have been free from headache loss of initiative, memory disturbance, and mental fatigue so common in the former group. They have returned to full activity in many cases within 3 months of the injury, where formerly a nine months' period of disability was to be expected. The patients have maintained a low fluid level of their own accord. "When they took more liquids they did not feel as well", they had headache, and dullness, and voluntarily returned to their former restrictions of fluid and diet.

Encephalography (3) has clearly shown that widespread cortical atrophy of the brain occurs within 3 weeks following cerebral trauma. Many post-traumatic cases have shown not only focal scars over the cortex of the brain, but an atrophy out of proportion to the site of injury or its extent and this atrophy of the cerebrum and cerebellum is bilateral and generalized. Pathologically such brains reveal anemic changes and degeneration similar to that described by Hassin (2) and termed *pressure atrophy*. An atrophy of the soft delicate gray matter of the brain is not surprising in view of our observations regarding pressure atrophy elsewhere in the body. When a ring is worn upon the finger, when glasses rest upon the nose or exert pressure upon the cartilage of the ears, when casts or constricting bandages are applied to the surface of the body characteristic pressure atrophy occurs. The results of pressure from a cast applied to the extremity and the rapid consequent atrophy are readily recognized and accepted by the profession. The fact that the brain is acted upon by an "hydraulic cast" encased by an unyielding skull seems to have escaped the recognition which it should have had from the profession.

The obstetrician depends upon hydraulic pressure for dilatation of the cervix in normal

labor. The hydraulic atrophy produced in distention of the bladder and renal pelvis is well recognized. The control, therefore, of a similar cerebral hydraulic mechanism is necessary to prevent widespread atrophy of the cortical surfaces surrounded by fluid (Fig. 3).

It is evident that the members of our profession interested in industrial medicine and the economic readjustment of patients suffering from head injuries must secure the early protection and subsequent preservation of the cortical areas so necessary for intellectual activity. The cerebral hydraulic pressure mechanism should be treated in the same manner in which one would deal with an obstruction to the neck of the bladder or renal pelvis, that is, continued and prolonged fluid drainage must be the first consideration, and the accurate control of fluid production should be maintained during the period of inadequate elimination. Thus, in attacking the problem from both angles we shall not continue the paradoxical treatment so long in vogue of draining the spinal canal or decompressing the brain, only to follow this beneficial procedure by immediately introducing large quantities of fluid into the individual by mouth, bowel or vein, destroying the advantages gained through cerebral decompression.

The fact must not be overlooked that surgical decompression as practiced formerly, only extends the limits of the confining skull and dura to permit the necessary expansion of the cerebral tissues, so that circulation may be adequately maintained to the vital centers. If the fluid volume is withdrawn from within the cranial cavity a more adequate decompression is maintained than that which surgery may offer as, at best, a subtemporal decompression is equal to approximately 90 cubic centimeters of volume space permitted by expansion of the brain into the new decompressive opening. If 3 ounces (90 cubic

TABLE I—CASE ANALYSIS

	Cases	Percent
Total cases of head injuries admitted to hospital	224	
Cases with bloody spinal fluid	104	46.4
Proved fracture of skull by X-ray	36	25.0
Surgical decompression	11	4.9
Total deaths	47	18.3
Deaths after third hour of treatment	29	12.5

TABLE II—ANALYSIS OF DEATHS

	Cases	Percent
Total deaths	47	
Died within first 3 hours of admission	12	29.2
Died of complications (ruptured liver, thorax, meningitis, etc.)	11	26.8
Surgical decompression deaths	10	24.3
Died after third hour from cerebral injury alone in spite of treatment	8	19.5

toma indicate the necessity of removing a clot. Here the exploration is not only indicated but imperative if the signs of focal pressure have established the presence of a subdural or epidural hemorrhage. The differential diagnosis is based upon several factors. A middle meningeal hemorrhage usually gives the clinical picture of a lucid interval with subsequent loss of consciousness with cortical irritative signs or focal signs developing rapidly in the presence of clear spinal fluid. Bloody spinal fluid should necessitate prolonged and careful observations as the bleeding responsible for this bloody spinal fluid has its origin from a rupture of a cortical or pial vessel and is not related to a subdural hematoma. When a subdural hemorrhage occurs in conjunction with subarachnoid bleeding the treatment indicated requires attention to the subarachnoid bleeding and intracranial pressure as a first consideration. The exploration for a coincidental middle meningeal hemorrhage may be delayed for hours or days and it has been our policy to await the seventh to tenth day when the patient's condition is satisfactory rather than enter the field of a middle meningeal hemorrhage in the presence of severe cerebral pressure and edema.

Too frequently we have had the experience of successfully removing a subdural hematoma only to encounter a rapidly expanding brain that filled the limits of the exploratory opening rupturing or disintegrating the brain substance before a closure of the scalp and muscles could be effected. Only one case in our series has survived where early exploration was necessitated in the presence of a combined subdural and subarachnoid bleeding. On the other hand the patients in whom the subdural hematoma was explored after the seventh to tenth day when signs of intracranial pressure had disappeared made prompt and satisfactory recoveries.

The surgical indications therefore in head injury are in our opinion clearcut.

1. Compounded comminuted fractures require early local débridement and care of the wound.

2. Local epidural or subdural hematomata require exploration at site of focal neurologic signs and not at point of fracture.

3. Decompression is a measure of last resort after all other methods have failed.

Frequent and continued spinal drainage in cases of bloody cerebrospinal fluid not only withdraws the overaccumulation of cerebrospinal fluid permitting better cerebral circulation but removes to some extent the red blood cells which are active in producing pachymeningitis and arachnoiditis the consequences of which become manifest in the post-traumatic sequelæ. The strict limitation of the fluid intake to prevent cerebral edema and cerebrospinal fluid formation must be maintained during the first 10 days and when bloody spinal fluid is encountered 30 total ounces of liquid are permitted the patient and a solid dry diet maintained (Fig. 4). This is ample fluid to maintain the necessary physiological requirements and permits the withdrawal of an accumulation of from 45 to 60 cubic centimeters of spinal fluid daily. If liquid diet or fluid in greater quantity is given an excessive amount of cerebrospinal fluid is formed and the patient's symptoms of stupor return requiring that the emergency measures of dehydration be repeated. If the spinal fluid is clear and there is no necessity after the first spinal drainage for further daily spinal fluid withdrawal the patient is allotted 20 total ounces of liquid so as to prevent the formation of spinal fluid and cerebral edema.

It has been found in our series that patients maintained on a solid dry diet and 20 total ounces of fluid per day promptly regain consciousness are free from headache and little or no spinal fluid can be obtained after the second day. This places the cerebral mechanism in a physiological state of rest free from hydraulic compression and permits the optimal cerebral circulation during the period of recovery it shortens the interval of unconsciousness and preserves the higher centers of intelligence. After discharge from the hospital (patients with severe cerebral trauma with or without bloody spinal fluid) the patient is placed upon a total of 32 ounces of liquid per day for the ensuing 3 months. The diet should contain solid food and strict avoidance of vegetables high in water content or excessive volumes of food should be emphasized. In this series of observations the

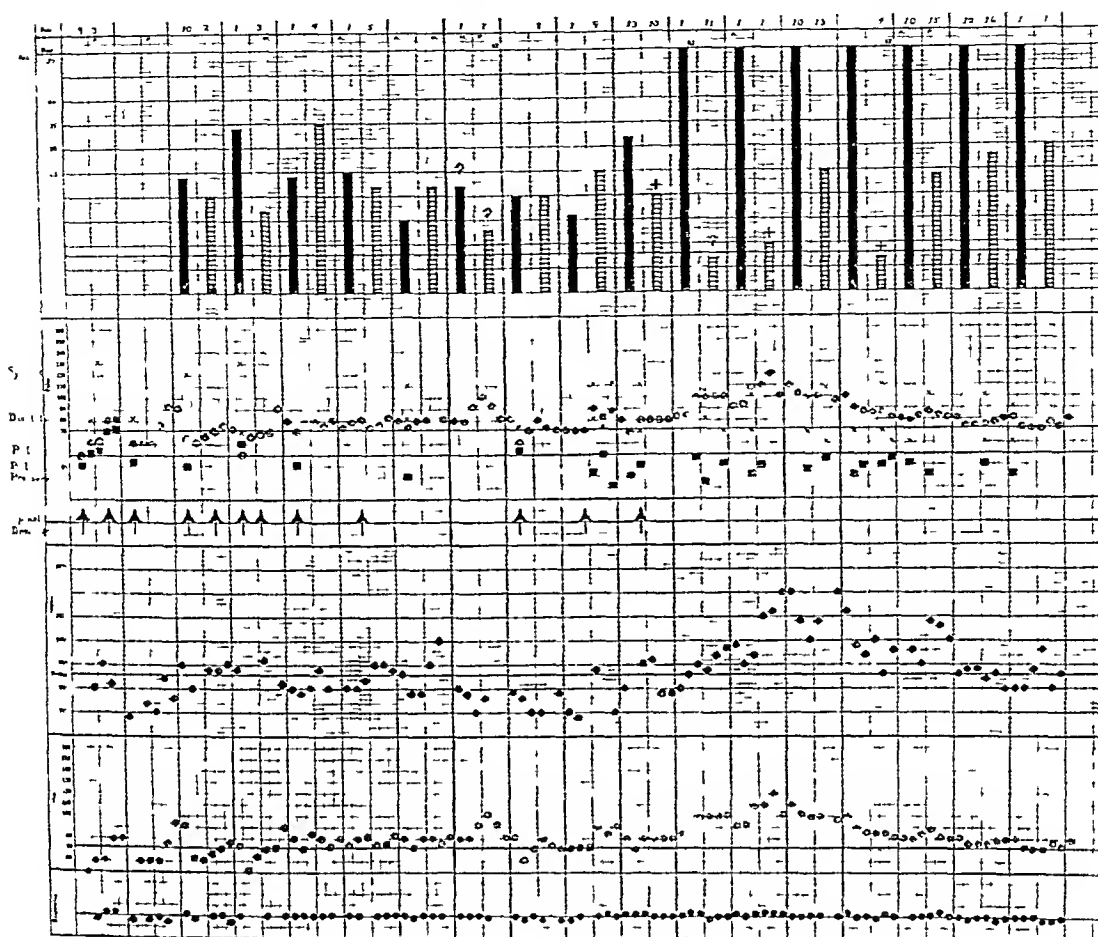


Fig 4 Clinical chart indicating the important considerations during the first 2 weeks following a severe cerebral trauma. Note that no fluids were permitted the patient during the first 2 days. Black columns represent total intake of fluid. Gray columns total output. Black squares pulse pressure, gray dots pulse rate, arrows indicate spinal drainage. On the fourth day 34 ounces of fluid intake produced crossing of pulse rate and pulse pressure

requiring further dehydration. On the seventh day water surreptitiously obtained, was followed promptly by rise in pulse pressure and fall in pulse rate, with stupor. Spinal drainage re introduced. After the tenth day the patient was able to take 50 ounces of fluid without further intracranial pressure disturbance. Note water storage during this period, indicated by low output.

vention, or subsequent to the pressure exerted at this point of opening. This leaves the patient with an organic loss of brain in the region of the decompression, superadded to the loss directly due to the injury itself. Not only is this a most important compensation factor, but a definite inferiority complex develops, characterized by fear and anxiety because of the opening in the skull, and this produces a typical post-traumatic psychosis. Finally, such disfiguring decompressive openings limit

the patient in his possibilities of securing work or engaging in activities that offer the slightest danger of trauma to the site of the cranial defect.

In summarizing the important industrial and economic aspects of head injuries, I wish to emphasize that early and continued dehydration as a form of decompression should be immediately instituted and continued to the point of recovery of conscious function. The hydraulic compression from chronic, in-

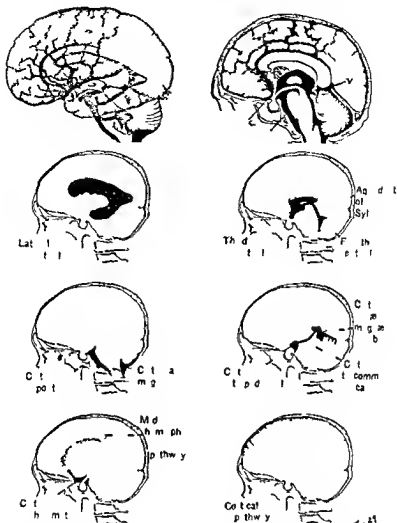


Fig 3. A d g mm t l t h p f th p n a l f d p th y t th r f f
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centimeters) of volume space is all that is necessary the patient will naturally survive and be benefited by the decompression. However too frequently the added space granted the cerebral contents is rapidly filled by the edematous brain and accumulations of spinal fluid secondary to unrestricted liquid intake. Curtailment of fluid intake, repeated spinal drainages and dehydrating hypertonic solutions on the other hand will usually control the volume of edema within physiological

limits without the necessity for surgical decompression and without the danger of further injury to an already traumatized sensitive cerebral mechanism.

To eliminate decompressions in the treatment of head trauma is to step further forward toward assisting in the industrial and economic readjustment of the patient because brain destruction and atrophy invariably occur at the site of surgical decompression whether inflicted at the time of surgical inter-

SPONDYLOLISTHESIS¹

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At a conference on industrial medicine and traumatic surgery, physicians will find that spondylolisthesis, is becoming of increasing significance as a factor in chronic backache. Physicians who are called on to fix responsibility for disability, to determine its extent and duration, and to relieve symptoms of backache, should always be alert to the possibility of spondylolisthesis being present. I am convinced that this deformity is not generally recognized, that it is more common than has hitherto been supposed, and that future study will prove its increasing significance in relation to chronic, disabling backache with or without associated injury (Table I).

Killian, in 1853, recognized spondylolisthesis as a clinical entity. He named it spondylolisthesis, and believed that it was due to caries and inflammation. Blake, in 1866, reported the first case in the United States. The patient was a multipara, aged 26 years, who had gained 100 pounds in weight. Neugebauer, in 1884, after a study of all anatomic museum specimens available, although recognizing defects in development, regarded injury as the principal cause. Lovett, in 1897, reported the first case of traumatic spondylolisthesis. Gibney described the case of a male patient, and this with Lovett's case was among the first 6 cases of male patients in 125 cases described previous to 1900 (Table II). The fact that in The Mayo Clinic 5 cases of this type were recognized in a month in 1931, and only 1 case was recognized in 1921, and that males (71 per cent) outnumbered the females (29 per cent) (Table III) contradicts the older teaching that spondylolisthesis is rare and is found mostly among women.

Farmers, laborers, and housewives constituted about 64 per cent of the 207 patients with spondylolisthesis observed in The Mayo Clinic. No doubt trauma is an etiological factor in spondylolisthesis, but obesity, preg-

nancy, and occupational strain may gradually bring on the condition. The patient may not associate the injury with the complaint because it was sustained months or even years previous to the onset of symptoms. Sudden severe injury may instantly disable the patient because of pain following subluxation. An increasing number of congenital defects of the fifth lumbar vertebra and first sacral vertebra, which apparently had not caused symptoms, is being observed in examinations made as a routine. When trauma tests the stability of these structures, displacement may occur, pain results from abnormal posture and weight bearing, strain on the ligaments, nerve stretching or pressure with muscle spasm and fatigue. A congenital defect could exist a lifetime without a patient's knowledge, even subluxation to a considerable degree could exist without symptoms (Table IV). It is my opinion that trauma is the exciting cause of spondylolisthesis, but that underlying it in most instances there is a defect in the lumbosacral region. Amazing changes in the lumbosacral angle and lordosis are further contributing factors (Fig. 1). Unfortunately, these anomalies have not been recognized frequently in the past. With modern methods of roentgenography, they are more easily recognized, and spondylolisthesis is more readily distinguished from arthritis, tuberculosis of bones, or fracture.

Ordinarily, strong ligamentous supports hold the inferior articular process of the fifth lumbar vertebra from slipping over the superior articular process of the sacrum, and in the absence of fracture or defect about the neural arch they prevent rotation and forward displacement. Evolutionary changes, assumption of the upright or perpendicular from the horizontal posture, and the late closure of the neural arch, have made defects, such as separation through the neural arch, and spina bifida occulta exceedingly common. I use the term separation about the neural arch, as it may be congenital or traumatic and vary in

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creased intracranial pressure should be controlled for a period of months following cerebral injury to prevent the increase of brain atrophy so characteristic in this group. The symptoms of post traumatic headache vertigo mental torpor mental deficiency loss of initiative and concentration may frequently be prevented if careful supervision and control of fluid intake have been maintained from the time of injury. Finally surgical intervention in traumatic injuries to the brain is distinctly limited to focal lesions and to the necessities for local debridement. Routine and indiscriminate surgical decompression as a method of treatment is no longer justifiable in the presence of newer physiological means at our disposal which not only benefit the patient to a greater degree but eliminate further injury and complications attendant upon surgical decompressions of the brain during the acute intracranial pressure phases.

In order to meet the growing industrial and economic dependency that these cases place upon the profession and society as a whole it is necessary to undertake the measures of prevention and relief during the early hours following the trauma.

It is only by initiating a program of protective measures directed toward the gnostic as well as the vital centers and placing the responsibility for maintaining these squarely upon the shoulders of the attending clinician that there is any hope of checking the enormous economic and social losses sustained each year arising from the problem of intracranial injuries.

BIBLIOGRAPHY

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TABLE I—CHIEF COMPLAINTS—JANUARY 1,
1918 TO SEPTEMBER 21, 1931

	Cases
Backache	101
Backache and pain in legs	35
Backache and pain in thighs	25
Backache and pain in hips	15
Pain in legs	11
Weakness in 10 cases, numbness in 30	
Other complaints (spondylolisthesis incidental findings)	20
Total	207
Average duration complaint	Years
Male	7 88
Female	9 64

TABLE II—CASES OBSERVED—JANUARY 1,
1918 TO SEPTEMBER 21, 1931

Year	Cases	Registration per cent
1918	2	0 004
1920	1	0 001
1921	2	0 003
1922	5	0 010
1923	5	0 008
1924	4	0 006
1925	14	0 020
1926	14	0 019
1927	17	0 023
1928	21	0 027
1929	35	0 044
1930	41	0 054
1931	46	0 092
Total	207	0 023

rows the birth canal. Jarring and jolting the spinal column may cause pain, patients usually walk carefully. Although the foregoing clinical observations are sufficient to make a diagnosis, roentgenograms, especially lateral views, are of great aid in determining accurately the degree of spondylolisthesis and the presence of anomalies, and in excluding tuberculosis, fracture, arthritis, and so forth. Anteroposterior roentgenograms cannot alone be depended on for the diagnosis of subluxation, although the shortened lumbar portion of the spinal column, the fifth lumbar vertebra superimposed on the sacrum, and the cocked up spinous processes, are strongly suggestive. By lateral roentgenograms the degree of subluxation may be graded 1, 2, 3, and 4 (Fig. 3). The condition of the neural arch, whether fractured, elongated, or defective congenitally, the shape and size of the fifth lumbar vertebra, the condition of the lumbosacral joint, as to angle and shape of the sacral

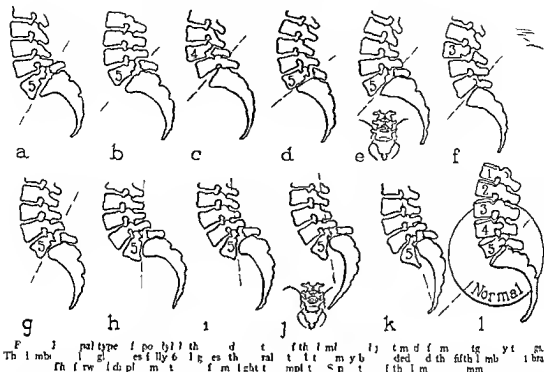


Fig. 2 Limited forward bending, depression and lordosis of the spinal column, with prominence of the fifth lumbar vertebra spinous process and sacrum in an adult patient with spondylolisthesis.

promontory, whether lipped or rounded, and so forth, should be noted.

Lateral roentgenograms should include the lumbar vertebrae and sacrum. The spinal canal should be carefully inspected as the displacement is more readily detected there, particularly the lesser displacements. The film is best studied with a moderate amount of light behind it; the spinal canal can be outlined with pencil on thin paper (Fig. 4).

Arthritis was the most common complication in the series; it occurred in about 20 per cent of the cases and was readily distinguished in carefully prepared roentgenograms and by the clinical history. Separation of the neural arch has been observed in as high as 70 per cent in a series of roentgenograms depicting definite spondylolisthesis. Spina bifida occulta of the first sacral vertebra is common (about 35 per cent). The fifth lumbar vertebra is commonly wedge-shaped, and the lumbosacral joint is misshapen with a lipped or rounded promontory of the sacrum (Table VII). Other diseases and deformities found associated in this series of cases were without significance. Arthritis occurred in 40 cases, which is no more than is to be expected at the average age of 40 years. Teeth were infected



situation. Age also may be a factor. In The Mayo Clinic series there were no patients aged less than 10 years, but roentgenograms were referred to me of 1 patient aged 5 years. The average age of patients in this series was 40 years. 80 per cent were between the ages of 20 and 60 years (Table V). Thus patient engaged in heavy work and in the active period of life come for relief most frequently.

The chief complaint of patients with spondylolisthesis is backache, often accompanied by referred pain to the sacroiliac joints, the hips, thighs, legs, and even the feet (85 per cent). No doubt many cases of so-called sacroiliac strain are in reality the result of injury to the lumbosacral articulations in which there are no clinically visible gross or roentgenologically. Weakness and numbness or a tingling feeling of the leg may be present. Stiffness of the spinal column, especially limited forward bending, is usually present. Muscle spasm is common. Deformity, such as prominence of the sacrum, lordosis, depression of the lower lumbar vertebrae, shortening of the torso, and broad pelvis are

rarely noticed by the patients unless called to their attention. Decrease in height was noted by a few patients. In the typical case the complaint is backache, slight lumbago, especially for hard work such as lifting and stooping, and slight weakness and stiffness of the spine, with relief of symptoms in a recumbent position. The average duration of symptoms in the series of 207 cases was 8.76 years, yet in only a small percentage had diagnosis been made (Table VI).

Clinical diagnosis was usually made by inspection and palpation of the back (Fig. 2), the depression above the sacrum, with sway back, muscle spasm, and prominent sacrum was almost enough evidence. A shortened torso, with broad pelvis, prominent erector spinae muscles, and abdominal crease appeared with well marked spondylolisthesis. In extreme deformity the rib may rest on the pelvis, and the patient will walk with the sailing gait that suggests congenital dislocation of the hip. Proctoscopic examination and careful palpation may disclose a hard fixed mass in front of the sacrum that nar-

TABLE V —AGE AND SEX—JANUARY 1, 1918
TO SEPTEMBER 21, 1931

Years	Male	Female	Total
10-19	14	5	19
20-29	27	10	37
30-39	43	15	58
40-49	26	12	38
50-59	28	10	38
60-69	8	6	14
70-79	2		2
80-89		1	1
Total	148	59	207

Average age male patients 38.59 years
 Average age female patients 41.32 years
 Oldest female patient 80 years
 Youngest female patient 11 years

TABLE VI —PREVIOUS DIAGNOSIS—JANUARY
1, 1918 TO SEPTEMBER 21, 1931

	Cases
Spondylolisthesis	19
Traumatic spine	5
Tuberculosis of spine	4
Curvature of spine	2
Rheumatism	2
Sciatica	2
Lumbago	2
Tuberculosis of hip	1
Kidney trouble	1
Sprain	1
Fracture of neck of femur	1
Hernia	1
Backache	1
Fracture of pelvis	1
Not diagnosed	164
Total	207

TABLE VII —SITE—JANUARY 1, 1918
TO SEPTEMBER 21, 1931

	Cases
Fifth lumbar vertebra on the sacrum	178
Fourth lumbar vertebra on the fifth lumbar vertebra	23
Third lumbar vertebra on the fourth lumbar vertebra	2
Reversed spondylolisthesis	4
Total	207

when patient may be permitted to be up, using a supporting jacket, corset, or brace. Operative results are good in properly selected cases.

SUMMARY OF ILLUSTRATIVE CASES

CASE 1 A stone mason, aged 46 years, complained of pain in the back, radiating into the hips and legs with occasional numbness. Thirty-two years previously he had sustained an injury to his back when a horse fell on him.

Examination disclosed limitation of motion of the spinal column, a shortened torso, and depression

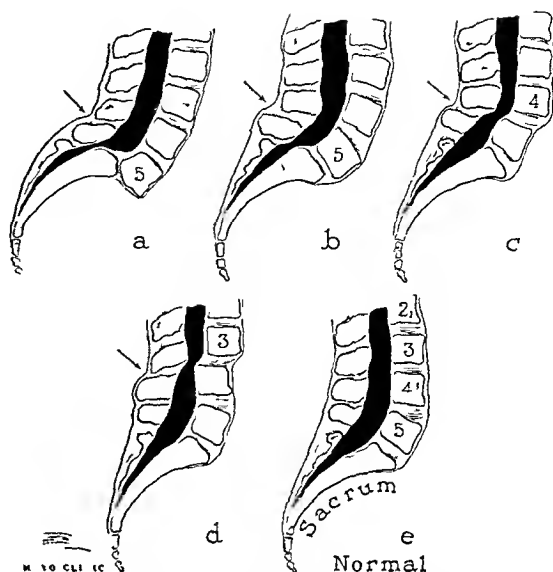


Fig 4 Sagittal sections through the lumbosacral area, showing the effect of displaced vertebra on the spinal canal: a, spondylolisthesis (graded 3) of the fifth lumbar vertebra on the sacrum, b, spondylolisthesis (graded 2) of the fifth lumbar vertebra on sacrum, c, spondylolisthesis (graded 1) of the fourth lumbar vertebra on the fifth lumbar vertebra, d, spondylolisthesis (graded 2) of the third lumbar vertebra on the fourth lumbar vertebra, and, e, normal spinal canal.

above the fifth lumbar spinous process. The Wassermann reaction of the blood and urinalysis were negative. The tonsils and teeth were infected. Anteroposterior roentgenograms disclosed spina bifida occulta of the first sacral segment, and the fifth lumbar vertebra slightly superimposed on the sacrum. Lateral roentgenograms disclosed spondylolisthesis, graded 1, and a wedge-shaped fifth lumbar vertebra with narrowed fifth lumbar joint.

The patient was operated on in August, 1928, a double bone graft and multiple bone chips were used to fuse the third, fourth, and fifth lumbar vertebrae and the sacrum. Result was good (Fig 6).

CASE 2 A farmer, aged 27 years, came to the clinic in April, 1925, complaining of pain in the back and legs, which had followed an accident 18 years previously. A diagnosis had not been made. The only treatment he had had was massage.

Examination of the back disclosed a short torso, prominent fifth lumbar vertebra and sacrum, and some limitation of motion, especially on forward bending. Urinalysis and the Wassermann reaction of the blood were negative. The patient appeared in good health otherwise. Anteroposterior roentgenograms revealed that the lumbar portion of the spinal column was shortened, the fifth lumbar vertebra was superimposed on the sacrum causing increased density. Lateral views revealed spondylolisthesis, graded 2, of the fifth lumbar vertebra on

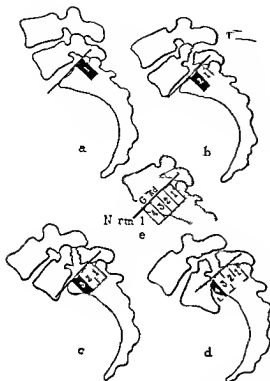


Fig. 3. Grafts for spondylolisthesis.

in 60 cases and tonsils in 64. Tonsillectomy had been performed in 37 cases. The Wassermann reaction of the blood was negative in 197 cases and positive in 3; the test was not made in 7 cases. Urinalysis was negative in 196 cases and positive in 11.

TREATMENT

In acute spondylolisthesis traction and recumbency are indicated and afford relief. Attempts at reduction have not been successful in proved cases. Suspension by the legs with an overhead frame would seem logical. Treatment for 6 weeks on a firm mattress or with the legs in a double spica cast is often desirable. Later a body cast well fitted to the pelvis affords relief from pain and a sense of security. For obese patients a corset with posterior steel stays fitted well down on the sacrum is most satisfactory (Fig. 5).

Fusion operations when operation is not contra-indicated after the method of Hibbs or Albee or combined as in my technique is

TABLE III—OCCUPATIONS—JANUARY 1 1918 TO SEPTEMBER 21 1931

	M	F	T
F m	48		48
H		44	44
Labo rs	39		4
Cl k	8	5	3
St d t	9	5	4
R l d mpl yees	9		9
Prof ss nal	7		7
I d o cut	7		7
M h	4		4
Cl gym	4		4
B k rs	3		3
T ch rs			
T tal	48	59	20

TABLE IV—TRAUMA—JANUARY 1 1918 TO SEPTEMBER 21 1931

	Cases
S	7
M ld	7
R p t d ep t d	3
S	4
St n	4
P gn y	4
N	6
N t m t d	7
T t l	7

preferred for those who must work and for the prevention of disability. I prefer to ankylose the third, fourth and fifth lumbar vertebrae and the upper two segments of the sacrum by two grafts fitted to the sides of the denuded spinous processes and sacrum. The laminae are exposed after the method of Hibbs; multiple bone chips and cancellous bone are packed between them and the spinous processes; the massive grafts are then held snugly against the freshened sides of the spinous processes by chromic catgut. A large osteoperiosteal graft taken from the tibia before removal of the massive grafts is then sutured over the posterior surfaces to cover the grafts and spinous process and sacrum. The wound is then closed without drainage and a heavy gauze dressing saturated with 70 per cent alcohol is applied and fastened by broad strips of adhesive plaster. The dressing is changed after a few days and one of dry gauze is applied. Care should be taken to have proper hemostasis; as infection may occur with drainage of the hematoma and present a serious complication. A cast is not used after operation until the sixth week.

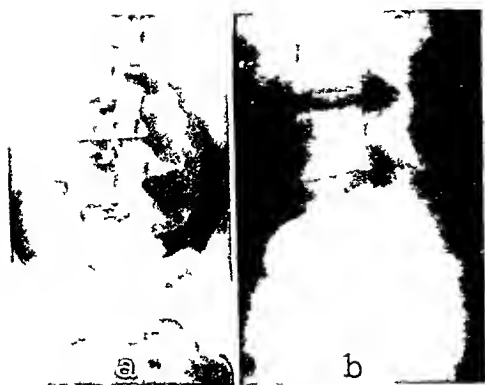


Fig 8 Spondylolisthesis (graded 3) of the fifth lumbar vertebra on the sacrum, a, anteroposterior roentgenogram, b, lateral roentgenogram Case 3

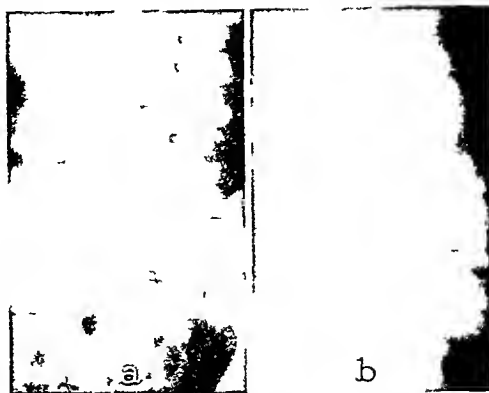


Fig 9 Spondylolisthesis (graded 4) of the fifth lumbar vertebra, a, anteroposterior roentgenogram, b, lateral roentgenogram Case 4

SUMMARY AND CONCLUSIONS

The data in this series of cases, in contradistinction to that of older literature, show that spondylolisthesis is more common among male than female patients, in 207 cases, 148 were males and 59 were females. Patients aged less than 10 years rarely have spondylolisthesis, it is most common between the ages of 20 and 60 years. Persons performing heavy labor are more commonly affected, the average age of these is 40 years.

Spondylolisthesis is usually recognized and is no longer a rare deformity, as has been taught formerly. It may be present without symptoms. Severe trauma with sudden onset of symptoms and chronic strain with gradual onset of symptoms are associated. The principal symptom is backache with or without referred pain in the legs. Trauma is the principal etiological factor ascribed by many patients. Congenital defects and the instability of the lumbosacral articulation is the anatomical factor.

The lumbosacral articulation varies in shape and angle, the latter may be abnormal to the extent of 60 degrees, thus aiding in the production of instability. Subluxation varies from partial to complete and may be graded on a basis of 1 to 4 as an aid to description.

Prominence of the sacrum and the fifth

lumbar spinous process is present to a varying degree. Shortened torso depression above the sacrum, broadened appearance of the pelvis, and abdominal creases are characteristic of well developed subluxation. Depression of the fifth lumbar vertebra, local tenderness and muscle spasm are common signs. The anteroposterior diameter of the pelvis is lessened, thus narrowing the birth canal. Rectal examination may disclose a fixed mass anterior to the sacrum.

Neurologic signs are usually absent, complete paraplegia is impossible at the level of the displacement (the lumbosacral joint) unless traumatic myelitis at a higher level occurs. Paræsthesia over the saddle area and referred pain are often present.

Lateral roentgenograms are valuable aids in diagnosis. Anteroposterior views may not disclose the lesion. Congenital anomalies, such as separation of the neural arch and spina bifida occulta are commonly observed.

Conservative treatment, including the wearing of corsets, casts and the like, gives a measure of relief, but fusion of the third, fourth, and fifth lumbar vertebrae to the sacrum is preferable, it prevents further deformity and increasing disability, it restores the patient's stability and well-being and he is able to work.



b

Fig 6 Sp dyl l th (g d l) f th fth lmb
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s i a l m b e s f the f e t u l t g f m

3 f o t f l l t h t h l c e d y e p o l
A d g o h d t b e e m a d
P a m i t f t h b k d c l s d h t t

b d e d p e l l r d s n d d p b the
f h t h l u m b r t b n d p o m c f the p s
p f t h f t h l m b t b d c r u m

The m e l i m t t f m o t f t h p l
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p t r t g g a m a l d l y the
h t e d l m l t e b r a t h t h f t h t b a



Fig 7 Sp dyl l thes g f e i f t h f t h l m b
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c r u m Th p o t b d r f t h b o l y f t h
f t h l m b a t e b t l j u t l t l n f r t f
t h e n t r f t h t e l s u f f t h e a e m
T h l m b c l j t l m t p p d l a
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b g l d g t l l t m
E x m n t n f t h p n l m l l d
s h t t s o s l g h t l i p a b o t h
f t h l m b r t b r n d p m e c f t h

u m d p u p f t h f t h l m b
t b The W a m e r t f t h l l f
d a l e g t e R t g g r a m
l e d h t d l m b a t b a f t h l u m b
t e b r a p m p d t h s a m p o n d l
l t h g d i 4 p r p n d l l m b o l j t
p b f d l t d f t l h T h
p f s d l m f t h e f t h l m b
t b a p p l t t h m f t h
p f e s f t h f t h l m b a t l
p h l b k l l d t f d p p e r p t
f t h s a u m p p l l t f t h t
p g t h u g h p t f t h f t h l f t h l m b e
t b a l m l h t l f f t h
s a m u d l

Th pat nt t f t t p e t p e t t
b o l t p p l d l h g h m c o
d r t l l f l l t l l t l f
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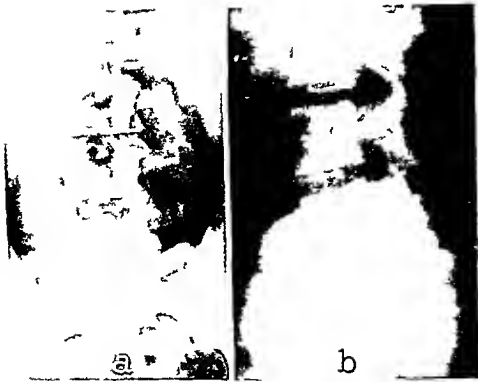


Fig 8 Spondylolisthesis (graded 3) of the fifth lumbar vertebra on the sacrum, a, anteroposterior roentgenogram, b, lateral roentgenogram Case 3

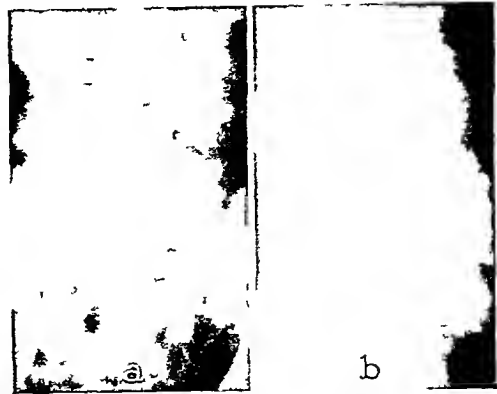


Fig 9 Spondylolisthesis (graded 4) of the fifth lumbar vertebra, a, anteroposterior roentgenogram, b, lateral roentgenogram Case 4

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LOCAL ANÆSTHESIA AS A FACTOR IN REDUCING THE MORBIDITY OF TRAUMATIC SURGERY¹

MORTON D. WILLCUTTS, G. T. LAKS, I. N. S.
 Lt. tena. Commandant, MC USN, FACS USN, IH 1

TRAUMATIC surgery is surgery of stress and as such the choice of anæsthetic should be carefully considered. We wish to emphasize the important rôle of local anæsthesia in reducing the morbidity of general surgery.

It is a law of surgery that every effort be made to preserve life, restore function, and erase the ravages of disease. The operative treatment does not always conclude this battle of mercy; the patient must continue the fight, often against additional odds induced by inhalation anæsthesia. Pitkin has shown the morbidity of inhalation anæsthesia to be 5 per cent at the operating table and 95 per cent during the week which begins 1 hour after the induction; that is, the secondary morbidity is 95 per cent of the total; the primary morbidity a meager 5 per cent.

The choice of the form of anæsthesia in the elective operation for chronic disease demands careful consideration. In the urgency of traumatic surgery this consideration of the anæsthetic

is often lacking, and the possibility of local anæsthesia is overlooked by many surgeons. Given a case of emergency surgery in any region of the body, the choice of anæsthetic often is lightly considered, routinely the patient is given one of the standard general anæsthetics. The anæsthesia is usually satisfactory, the operation is completed, and the patient is returned to his bed, having safely passed the immediate dangers attending its administration. The indirect later dangers, constituting the 95 per cent of Pitkin, such as postoperative shock, vomiting, dehydration, acidosis, alkalosis, pulmonary complication, distention, ileus, renal suppression, and pain, are yet to be faced. It is granted that these indirect complications may not be charged to the general anæsthetic; certainly the operative lesion and operative technique must be included. Yet in a broad sense the anæsthetic is an important factor, since under local anæsthesia operative technique is gentle and meticulous, affording a methodical approach by

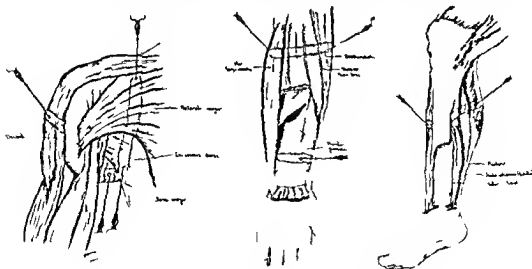


FIG. 1. Diagram of the surgical approach to the tendon, nerve, artery, and vein. Presented at the Conference on Traumatic Surgery, 1941, at the American College of Surgeons.

which the operative lesion may be safely attacked without trespassing upon brain or uninvolved parts

Local anæsthesia long ago passed the experimental stage. It is now generally accepted that its scope may include any operation. It is not a surgical fad, but a most valuable aid to surgery. An enthusiastic conviction obtained from year after year of general surgery performed almost exclusively under local anæsthesia has led me to relegate general anæsthesia to that small percentage of cases in which some type of local anæsthetic may not be successfully employed. The comfort and safety of the patient and the success of the operations have so consistently improved that for over 6 years more than 99 per cent of our cases have been primarily scheduled for local anæsthesia.

The United States Naval Hospital at Great Lakes is a general hospital for the care of active and retired Navy personnel and for a large number of referred Veteran Bureau patients. There was a daily average of 683 patients during the past two years (with 6,792 patients admitted and 6,665 discharged during the past 19 months). From January 1, 1930, to September 1, 1931, 2,043 operations were performed by the general surgical service. Local anæsthesia was induced in every case, and only 8 required the addition of inhalation anæsthesia (see Table).

Lundy gives the following points as the preliminary considerations for determining the choice of an anæsthetic: first, the mental and physical condition of the patient; second, the proposed operation; third, the technique of the surgeon; and fourth, the experience of the anæsthetist. We agree with him in his conclusion: "No agent or method



Figs 4 and 5 Fracture of body, seventh cervical vertebra. Full recovery following 3 months' immobilization in doll plaster cast. Anæsthetic not necessary.

has been developed which can be used as a routine without danger." We feel that local, regional, or spinal anæsthesia may be made the basis for the safest anæsthesia by the careful selection and combination of local methods with the temporary addition of an inhalation agent when necessary. We employ the term



Fig 6, left Osteomyelitis right arm with ankylosis of shoulder joint.
Fig 7 Healthy amputation stump following disarticulation of arm. Brachial anæsthesia.



Fig 8



Fig 9



Fig 10



Fig 11



Fig 12



Fig 13

Fig 8 F t d loc t g l eck f b m ru
 Fig 9 Ope ed t b l t ec ry R
 Fig 10 block d tram sc la ject ns
 Fig 11 Comm ted fra t f m
 Fig 12 Red t d J p l lges

Fig 14 M l pl d g m es f m f t 1
 gh f m st g bo pl t 0 5 by 6
 sc w d 8 sc w La bo pl t 0 4
 Fig 15 A est f fect ih led w lf fl w g
 m l f b c plates p al lges

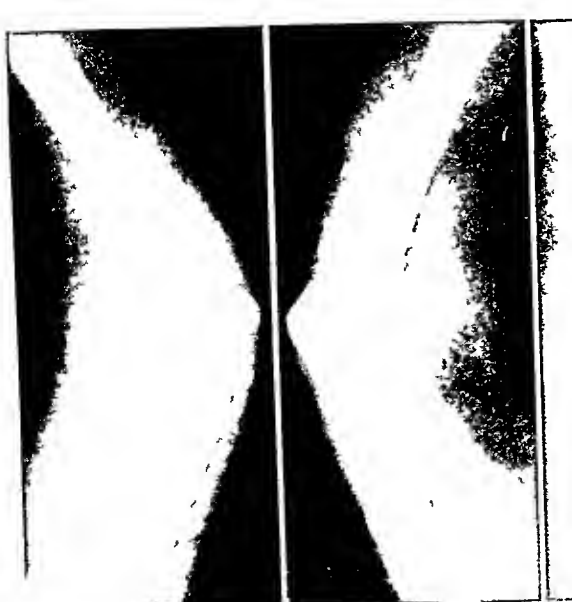


Fig 10

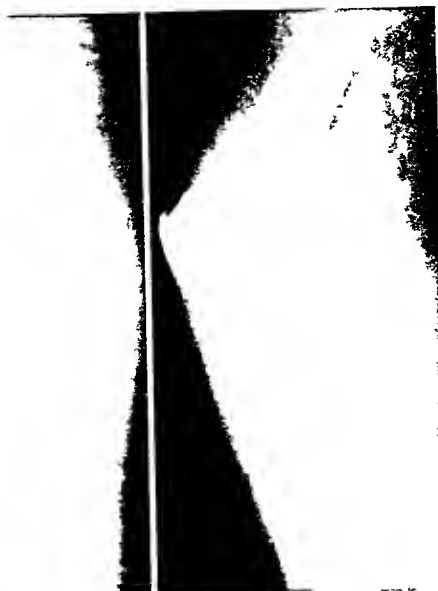


Fig 11



Fig 16

Fig 17

Fig 10 Fracture of olecranon process
Fig 11 Union and functional recovery Regional block
and intramuscular injections

Fig 16 Comminuted fractures tibia and fibula
Fig 17 Strong union following reduction by skeletal
traction Low spinal analgesia



Fig 8



Fig 9



Fig 10



Fig 11



Fig 12



Fig 13

Fig 8: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

Fig 9: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

Fig 10: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

Fig 11: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

Fig 12: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

Fig 13: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

Fig 4: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

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Fig 7: A black and white photograph showing a close-up of a surgical site, likely a pelvic or abdominal incision, with visible tissue and sutures.

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UNITED STATES NAVAL HOSPITAL, GREAT LAKES, ILLINOIS—OUTLINE OF GENERAL SURGERY
FROM JANUARY 1, 1930, TO SEPTEMBER 1, 1931

Classification of operations	Number	Type of Anæsthesia						Mortality	
		Local infiltration and regional block	Local infiltration and spinal analgesia	Straight spinal analgesia	Caudal block	Temporary addition of inhalation agent	Straight general anæsthesia	Immediate anæsthetic or operating room death	Post operative deaths
Surgery of head and neck	198	198	00	00	00	00	00	00	0
Surgery of chest	105	10	00	00	00	00	00	00	0
Surgery of abdomen	175	73	41	76	386	8	00	00	7
Genito-urinary surgery	134	8	00	19	30	00	00	00	1
Surgery of bones joints muscles and tendons	219	181	00	38	00	00	00	00	0
Surgery of the blood and lymph systems	133	133	00	00	00	00	00	00	0
Totals	2043	1453	41	133	416	8	00	00	12*

The 12 deaths were due to General Peritonitis 2 Osteomyelitis chronic 1 Hyperthyroidism 1 Carcinoma 2 Tuberculosis of kidney 1 Tuberculous Pelvic Abscess 1 Gangrene leg 1 Gastric Hemorrhage 1 Mesenteric Vascular Occlusion 1

The female patient has responded to the use of local anæsthesia just as well as the male, and as operating surgeon at the Veteran Bureau Hospital for the Insane I have found that insane patients are surprisingly good subjects. Under local anæsthesia we have had no operating room mortality, no death from anæsthetics, no primary shock or accident.

We consider the induction of spinal anæsthesia to be a major procedure and feel it should not be routinely and freely employed. The widespread recent popularity of spinal anæsthesia is not without danger. The proposed operation should exceed in gravity and importance the anæsthesia induced, hence we disfavor the routine employment of spinal anæsthesia in appendectomy, repair of hernia, rectal, and minor genito-urinary cases. We favor spinal anæsthesia and employ it freely when the disease is of sufficient gravity to justify the important measures necessary for its safe administration. It is not foolproof and should be employed cautiously in patients with definite cardiac disease, hypotension, marked asthenia, and in advanced age. It should be used only when the field of operation is below the diaphragm. Local infiltration and regional field block carry no such restrictions and may be employed safely in any zone of the body.

It is accepted that general anæsthetics disturb the chemistry and metabolism of the body. Bloor has shown that chloroform and

ether, acting as fat solvents, produce a very definite increase in the fat content of the blood stream during prolonged anæsthesia. This condition is enhanced by pre-operative starvation and postoperative vomiting. This metabolic disturbance does not occur with local anæsthesia, the pre-operative preparation does not require withdrawal of food, preliminary catharsis is not needed, and the morning meal is permitted.

Vomiting, which is so common following general anæsthesia, is a rare occurrence after the use of local anæsthetics, and when present is seldom severe or prolonged. It may prove an annoying factor during the operation under spinal anæsthesia, but usually may be readily controlled by the use of oxygen.

Dehydration, or the loss of body fluids, due primarily to the organic lesion and accentuated by prolonged general anæsthesia, may produce serious concentration of the blood with resulting disturbed metabolism and production of an acidosis, ketosis, or alkalosis. Local anæsthesia, limited to the pathological or traumatized zone, adds little or no extra burden. Fluids and food are permitted early, and metabolism may be kept in equilibrium from the first day of operation.

Pulmonary complications occur following local anæsthesia, but to a far lesser degree in severity and frequency than after inhalation anæsthesia. There were no cases of lobar pneumonia in the above series. A productive

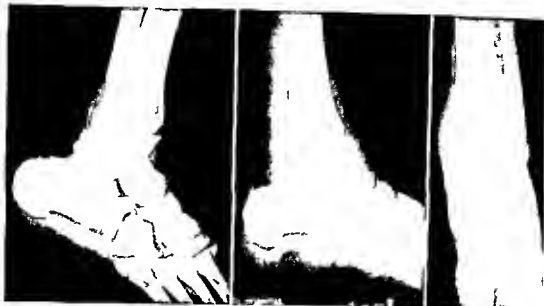


Fig. 8. Left foot and ankle, showing the results of the surgical procedure. The patient is lying on her back, and the foot is extended. The surgical incision is visible on the lateral aspect of the foot. The patient is wearing a white sock and a white shoe.



Fig. 9. Left foot and ankle, showing the results of the surgical procedure. The patient is lying on her back, and the foot is extended. The surgical incision is visible on the lateral aspect of the foot. The patient is wearing a white sock and a white shoe.

local anesthesia to include local infiltration, regional field and nerve blocking and spinal anesthesia. By combining local infiltration with field blocking or operative zone infiltration with low spinal anesthesia, we have been able to restrict inhalation anesthesia to a small percentage of cases, and then only for a temporary period during difficult manipulations. We use only procaine hydrochloride in strength of 3

per cent combined with a small amount of epinephrin (4 to 6 minims of 1:1000 solution to each 100 cubic centimeters of procaine) or ephedrin. For spinal anesthesia we dissolve the procaine in spinal fluid and limit the dosage to 1 milligram for each pound of body weight. We have found local anesthesia adaptable to all types of patients, with the exception of children under the age of reasoning.

rendered by the co-operation of the patient makes possible good reduction and later maintenance in simple fixation and traction splints. The reduction in morbidity is obvious. The primary and secondary dangers of anæsthesia are reduced to the remote possibility of local infection, nerve trauma, and emboli, which are factors that we have not encountered. The period of hospitalization is reduced, and the ambulatory class of fractures is much increased. The patient witnesses the reduction and from the start becomes an able, interested assistant.

Traumatic wounds, especially those involving severed tendons and nerves and amputations, are excellent cases for the use of local anæsthesia. Here again the patient serves as an efficient assistant by co-operating in the voluntary manipulations of the traumatized lesion. Difficult identifications of tendons, nerves, and important structures are made easier. Restoration of function is seen at the close of the operation. As in the treatment of fractures, we have noted the relaxation following the intramuscular injection of procaine. McNealy and Lichtenstein have shown that intramuscular injections of novocain prevent the reception of nerve stimuli by acting on the motor nerve end-plates. Recently severed tendons without loss of substance seldom require repeated postoperative injections to limit undue tension on the suture line as the relaxation at the primary repair permits strong suturing without tension. In severe cases of retracted tendons or loss of substance, the repeated injections, as reported by McNealy and Lichtenstein, appear justified.

The attending shock and associated morbidity in major wounds requiring amputation are controlled and lessened by regional anæsthesia. The hurried amputation with possible undue sacrifice of tissue is not seen under local anæsthesia, and an orderly plastic amputation may be regularly performed.

Wounds heal kindly following local anæsthesia. The use of procaine does not delay wound healing, and there is little or no resulting transudate, while cosmetic scars are easily obtained. Employed in the usual combination with epinephrin, the injections pro-

duce only a pressure sensation following the fleeting needle prick of the skin and contact with the regional nerve endings. Even local infiltration carried to an excessive degree of cedematization is readily absorbed and leaves only a dilatation of the capillaries as an epinephrin reaction. The suture lines are protected by the relaxation and protracted physiological rest of the regional muscles so that postoperative repair is hastened. Local anæsthesia demands gentle operative technique, and thus a minimum degree of operative trauma results. It is axiomatic that wound infection decreases as respect for tissue increases.

The time allotted will not permit detailed discussion of anæsthesia and operative technique. Figures 1, 2, and 3 demonstrate the intramuscular injection of procaine in the reduction of fractures. Figures 4 to 21 carry explanatory notes showing the scope of local anæsthesia in surgery of bones and joints.

In conclusion, we cannot emphasize too strongly that traumatic surgery affords an ideal field for local anæsthesia. The advantages are great to both patient and surgeon. The development of local technique increases respect for tissue, the surgeon is required, and the patient blessed by a gratifying reduction in postoperative morbidity. The current series of over two thousand consecutive general surgical cases show the extent and safety of the scope of local anæsthesia. The employment of intramuscular injection of procaine in the treatment of fractures is particularly emphasized, and it is hoped that the extension of the scope of local anæsthesia by the expedient combination of local infiltration with regional blocking, or in combination with spinal analgesia, may create critical comment.

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bronchitis occurred in 3 per cent of the abdominal cases none was severe and rapid recovery took place within the first week. Massive collapse of the lungs occurred twice with spontaneous recovery under simple postural treatment. There was no case of lung abscess. Simple postoperative intubation to the patient awake and alert in the operating room to expand his lungs and to breathe deeply at hourly intervals has diminished our pulmonary complications.

The silent abdomen so nicely experienced in abdominal operations under local anesthesia permits gentle methodical approach and mobilization of the lesions, less traction and manipulation of uninvolved parts and results in minimum operative trauma. The incidence of distention and gas pains is reduced markedly. In the above series paralytic ileus occurred only twice with prompt relief by gastric lavage. Our surgical ward has lost the notorious postoperative days of stress, hours of discomfort and danger to the patient—a period often testing the skill and patience of doctor and nurse. At Great Lakes we are able to group our postoperative patients in ward of 32 beds and the postoperative ward requires for efficient care only one nurse and four corpsmen in daily attendance and but two attendants at night.

Renal suppression of clinical note did not occur in this series. Catheterization has been markedly reduced but not eliminated.

Postoperative pain is chargeable to many factors. The operative site oddly enough may not be the seat of serious pain for here there is usually only a receding zone of tenderness or ache aptly described as a bruise. The patient who has been given a general anesthetic is subjected to the strain of confining straps upon the operating table. He knows nothing of the struggles, delirium, gagging and suffocation while under the anesthetic and wonders why he feels as though he has been in a football scrimmage. Contrast this experience with that of the patient under local anesthesia alert to his own comfort with freedom to move and shift his position at will of relative ease. He leaves the operating room mentally and bodily at ease, cheerful in the knowledge that he has co-operated in the

operation and pleaded that his adventure has dispelled his old horror of the surgeon and of the operating room.

The treatment of fractures, dislocations, severed tendons and traumatic wounds falls easily within the scope of local anesthesia. Here again the morbidity is reduced by confining treatment to regional parts.

The reduction of a fracture is a mechanical problem. The restoration of good alignment and apposition of the fragments largely dependent upon control of muscular relaxation. General anesthesia gives only transitory relaxation, casts splints and traction must be depended upon to maintain the reduction often through postanesthetic delirium and the indefinite period of overpowering muscular effort in traction fatigue and atrophy of disuse. Local anesthesia favors a rational reduction based on the fracture site and the all important associated mechanics of muscular contractions. The intramuscular injection of procaine into the bellies of the contracted muscles with a regional block of the sensory nerve produces a combined analgesia and deep muscular relaxation that permit reduction under the fluoroscope. The patient serves as an ideal assistant ably co-operating in shifting position and making countertraction when necessary. There is no pain and the analgesia persists 2 to 4 hours after the reduction. Most important is the sustained relaxation of the muscles which in major fractures may be controlled indefinitely by repeating the intramuscular injections. Brachial anesthesia will control any fracture or dislocation of the upper extremity but unfortunately this method of anesthesia demands a delicate technique in reaching the plexus that is not always attained. The regional block and intramuscular injections give longer relaxation. Spinal anesthesia is the anesthesia of choice for fracture of the pelvis and femur. Below the knee the sensory block and intramuscular injections are indicated as the muscular attachments and contractions are readily reached. The above types of local anesthesia are indicated in open as well as closed reduction. A large percentage of closed reduction is possible as the sustained relaxation of the muscle in place and the very important and

committee, with the result that at all times the material appearing in the public press was authentic and ethical, and devoted entirely to the scientific aspects of surgery and the ideals and activities of the College

Of great importance was the extensive utilization of radio broadcasting. All the large local stations, many with national hook-ups, were utilized two or three times daily for the dissemination of useful and timely public instruction. A few of the titles of these five-minute radio broadcasts will indicate their general scope and importance: "The American College of Surgeons, Scientific Medicine and the Public", "Your Personal Responsibility for Health", "Cancer and Pain", "Reducing Cancer Mortality", "Choosing Your Hospital", "The Hospital and the Community", "What Cancers Can be Cured", "Dividends of Medical Science", "Conservation of Life and Limb Following Industrial Injuries", "Adding Years to Your Life"

The evening scientific meetings of the Congress measured up to the high order of previous congresses, the papers being of outstanding importance by reason of the high scientific attainments of the authors and the teaching value represented in their subjects. At the Presidential Meeting on Monday evening, following addresses of welcome by Drs. Charles Gordon Heyd and John E. Jennings, the distinguished foreign guests were introduced. The retiring president, Dr. C. Jeff Miller, of New Orleans, gave a memorable address on "Medical Men and Their Lay Critics". This was followed by the inaugural address of Dr. Allen B. Kanavel, of Chicago, on "Fundamentalism and Social Progress in Medicine". The John B. Murphy oration in surgery by Mr. Arthur H. Burgess, professor of clinical surgery in Victoria University, Manchester, England, on "Murphy,

and Some Principles of Urinary Surgery" was in keeping with the splendid traditions of the College and presented Murphy as a signal and outstanding contributor to the development of urological surgery.

A wide range of surgical subjects was covered by the programs for the scientific sessions on Tuesday, Wednesday, and Thursday evenings, and a mere citation of the titles and their authors indicates their high quality: "The Present Status of Cardiac Surgery," Elliott C. Cutler, Cleveland, "The Operative Approach to the Heart and Pericardium," Arthur M. Shipley, Baltimore, "Technique and End-Results in Denervation of the Adrenal Glands," George W. Crile, Cleveland, "The Newer Concept of Chronic Arthritis," Ralph Pemberton, Philadelphia, "A New Method of Operating for the Repair of Ruptured Cruciate Ligaments of the Knee Joint," William R. Cubbins, Chicago, "Some Old Truths about Fractures," William Darrach, New York, "Peritoneal Adhesions: Their Prevention by the Use of Digestive Ferments," Alton Ochsner, New Orleans, "Further Experiences with Fascial Repair of Hernia," W. Edward Gallie, Toronto, "Curability of Cancer of the Stomach," Donald C. Balfour, Rochester, Minn., "Some Experiences in the Treatment of Carcinoma of the Rectum with Radium," Sir Charles Gordon-Watson, London, England.

The special meetings at the Academy of Medicine on Tuesday and Wednesday evenings, devoted to the discussion of subjects of interest to those surgeons who practice in the special fields of ophthalmology and otolaryngology, were attended by large audiences and contributed greatly to the scientific excellence of the program. The speakers and their subjects were as follows: "An Outline of the Activities of the Otological Research Laboratory of the Johns Hopkins University During

EDITORIAL

SURGERY, GYNECOLOGY AND OBSTETRICS

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FEBRUARY 15, 1932

THE 1931 CLINICAL CONGRESS

THE twenty first annual Clinical Congress of the American College of Surgeons held in New York and Brooklyn from Monday October 12 to Friday October 16, 1931 was the fourth Clinical Congress held in these cities. In comparison with the three previous sessions—in 1912, 1919 and 1924—the twenty first Congress may well be considered the most successful of all. The 1931 session was particularly noteworthy by reason of the large number of surgeons in attendance, the high technical quality of the surgical clinics, the important conferences devoted to hospital standardization, the notable character of the cancer symposium, the conference on methods of teaching of surgery, the fracture exhibit and demonstrations and the conference on industrial medicine and traumatic surgery.

The large and beautifully decorated public room of the new Waldorf Astoria Hotel provided a most attractive setting for Clinical Congress headquarters with unusual facilities for handling so large an attendance.

The surgeons of New York and Brooklyn contributed a clinical program that embraced every phase of surgical endeavor in which all the important hospitals of the metropolis were represented. In addition to an extensive schedule of operative clinics there were numerous clinical demonstrations and symposia contributing greatly to the value of the clinical program. There were numerous demonstrations in roentgenology, surgical pathology and surgical research in the hospital, medical school and allied institutions. It was found that the visiting surgeons distributed themselves easily among the various hospitals so that the clinics were well attended.

In recognition of the splendid clinical facilities of Brooklyn, Wednesday, October 14 was set aside as Brooklyn Long Island Day so that the clinics in the hospital of Brooklyn and its suburbs were favored with a larger attendance than at any previous session.

The evening meeting in the ballroom of the new Waldorf Astoria where the paper dealt with various phases of general and special surgery were attended by large audiences filling the ballroom to its capacity each evening. Special meetings of the sections on ophthalmology and otolaryngology of the New York Academy of Medicine through the courtesy of the officers of those sections formed a distinct addition to the scientific program.

To provide for a proper contact with the public through the daily newspaper department of publicity was organized through which all publicity relative to the Congress was handled under the supervision of a press

PRESIDENTIAL MEETING, CONVOCATION

ADDRESS OF WELCOME—NEW YORK¹

CHARLES GORDON HEYD, M.D., F.A.C.S., New York

ON behalf of the medical profession of the City of New York I am happy to bid you welcome and sincerely hope that your visit will be profitable, educative, and pleasant.

In the 7 years since the last Congress met in this city, we have all observed the remarkable change that has taken place in medical education, medical sociology, and in the practice of medicine, *per se*. The forces that have operated upon the practice of medicine have, within the last few years, co-ordinated themselves with the result that there have been erected in this city two medical centers, representing two of the most constructive projects in medical sociology and in medical practice. We have all witnessed the era of mergers in industry and it was not to be doubted but that our medical institutions and hospitals would be affected by this trend of the times and merge with their affiliates. The result is that today in our city we have the Medical Center of Columbia University and the Cornell-New York Hospital Medical Center. Both of these gigantic projects are the resultant of many lines of force and their object has been to create what their names imply, namely, a center for the treatment of disease, for alleviation of human suffering, for research, for medical progress and for the training of young men to become adequate, competent physicians and surgeons.

We invite you to witness what the profession of New York has to offer in the daily run of its activity. By far the larger number of hospitals participating in this Congress are institutions that are dedicated to the teaching of medicine and

combine within themselves or their affiliates large teaching facilities. Their work then represents the quality of surgical practice as it may be observed by and large throughout the entire city.

The attending staffs of the various institutions are engaged in a process of continuous education in the art, science, and practice of surgery. Working in approved hospitals, with proper clinical records, with frequent adequate staff meetings, by periodic mortality and morbidity surveys, together with a comprehensive follow-up system, the surgeons of our hospitals are carrying out successfully, I am sure, the object and aim of the American College of Surgeons as it is represented by its membership throughout this country.

The hospitals participating in the Congress are all on the approved list of hospitals of the American College of Surgeons, and the surgeons participating in the clinics are for the most part members of the College.

On behalf of the Medical Society of the County of New York, and in equal measure for the Medical Societies of Kings, Queens, the Bronx and Richmond, we are happy to have you here as visitors and guests.

We sincerely trust that our efforts will not prove unavailing in indicating to you the material progress that has been made in research, in clinical surgery, in surgical technique, and in the lessening of hospital mortality and morbidity. Everything we have is yours and the measure of our welcome is the zeal with which we look forward to showing you all that is worth while in the domain of clinical surgery.

¹Presented before the Clinical Congress of the American College of Surgeons, New York, October 1-2, 1931.

the Past Five years Samuel J Crowe
Baltimore Some Intimate Studies of Nasal
Function Their Bearing upon Diagnosis and
Treatment Arthur W Proetz St Louis

Clinical Phases of Industrial Injuries of the
Eye and Orbit Edward B Heckel Pitts-
burgh George H Cross Chester Pa E S
Sherman Newark and Henry S Miles
Bridgeport Conn Pathological Specimens
Bernard Samuel New York Workmen's
Compensation Problems of Interest to Oph-
thalmologists V A Zimmer director
Division of Workmen's Compensation New
York State Department of Labor The
Prevention of Industrial Accidents to the
Eye and Orbit Louis H Carrs director of
the Society of the Prevention of Blindness
New York

At the nineteenth Convocation of the
American College of Surgeons on Friday
evening October 16 honorary fellowships
were conferred upon three distinguished
European surgeons and 642 candidates of
the Class of 1931 were admitted to Fellow-
ship in the College With conciseness and
clarity of diction the President Dr Allen B
Kanavel taking for his theme The Program
of the College and the Initiates Respon-
sibility placed before the candidates their
responsibilities upon becoming Fellows of the
College and appealed to them to uphold a
standard of professional conduct in keeping
with the high resolution of the College The
Fellowship address by Dr James R Angell
president of Yale University Medicine and
the Contemporary Social Order reviewed the
contacts of medicine with the present social
order The masterly arrangement of facts
based on service to the community was pre-
sented with a broad underlying humanitari-
anism

A community health meeting in the
Academy of Music in Brooklyn on the eve

ning of Wednesday October 14 proved a con-
structive innovation attracting probably the
largest attendance that has ever attended
any medical meeting in Greater New York
Dr John E Jennings chairman of the
Brooklyn Committee on Arrangement pre-
sided The speakers were Franklin H
Martin Chicago Allen B Kanavel Chicago
Malcolm T MacEachern Chicago Joseph
C Bloodgood Baltimore Frederic A Besley
Waukegan Illinois George W Crile Cleve-
land C Jeff Miller New Orleans Charles
H Mayo Rochester and Robert Jolly
Houston

Certain features of the twenty first Clinical
Congress seem to be worthy of special
emphasis There was manifest throughout
the Congress a larger public interest in
medicine and surgery The publicity at all
times was informative and instructive and
with the aid of national and international
press associations the message of the College
was given a wide geographical distribution
The radio broadcast with the happy se-
lection of subjects and the distinguished
character of the speakers served further to
extend the influence of the College in a man-
ner quite remarkable

To the Fellows of the College both old and
new there came a marked personal appre-
ciation of their duty to the community and a
proper appraisal of their personal responsi-
bility to the high art and the splendid altru-
ism of their profession Even to the casual
observer it was apparent that from the time
of the first Congress in New York City in
1912 the College has grown in stature and in
prestige This twenty first annual Congress-
the fourth in New York served further to
accentuate the warm place the College
occupies in the hearts and thoughts of the
profession in the greater city of New York

CHARLES GORDON HEYD

MEDICAL MEN AND THEIR LAY CRITICS¹

C JEFF MILLER, M D, F A C S, NEW ORLEANS

THERE is a sixteenth century version of an old Latin epigram which has to do with the three different aspects a physician can present under three different sets of circumstances

"Three faces the Physition hath
First as an Angell he
When he is sought, next when he helps,
A God he seems to be,
And last of all, when he hath made
The sickle, diseased, well
And asks his guerdon, then he seems
An oughly Friend of Hell "

Those same circumstances still prevail, gentlemen of the American College of Surgeons, and in the last aspect we are still all too well known, but the articles that have been appearing about us recently in the lay journals can be interpreted only as meaning that our angelic and our godlike qualities are no longer very apparent. In these days criticism that is usually highly unfavorable and abuse that is frequently close to scurrilous are part of our daily bread. I know, as Kipling puts it, that "doctors always have been and always will be exposed to the contempt of the gifted amateur, the gentleman who knows by intuition everything that it has taken them years to learn," but that does not explain everything. It does not explain the presence of these articles in magazines whose standards, one used to believe, were rather higher than the publication of half truths and misrepresentations and downright falsehoods. I confess that a rather unworthy suspicion has crossed my mind that it has perhaps been easier for our traducers to gain a hearing than it has been for our defenders. Here and there a physician has raised his voice, not always, I am sorry to say, with very profound wisdom, but lay defenders are notably absent, and I find it rather hard to believe that an occasional satisfied layman, an occasional grateful patient, has not tried to say something in our favor.

I cannot help wondering, as I ponder on these articles, whether medical service has really declined to as low a level as the writers would have us believe, or whether the explanation is that the age demands a victim and the medical profession has always been fair game. A good many of the charges, of course, we richly deserve. More than other men, perhaps, we have left undone the things that we ought to have done and done the

things that we ought not to have done, but surely we cannot all of us be so steeped in ignorance and incompetence, so far gone in iniquity and avarice, as these all-knowing ladies and gentlemen would have us believe. The old fault of generalizing from insufficient evidence, of making deductions from a single instance, not to mention speaking dogmatically on subjects about which one knows exactly nothing, are everywhere glaringly apparent. What they say is all of it true about some of us, and some of it true about all of us, but that all of it could possibly be true about all of us is a preposterous assumption. I get the impression, as I read, that most of the writers were in the state of mind of the Roman Chesterton describes, who made his living, if I recollect aright, by flinging Christians to the lions, he did not feel it necessary to know very much about the religion they professed, for, as soon as he heard of it, he hated it. They likewise seem to me to resemble a certain Scotchman of whom I once read, William Douglas by name, who was "always positive and sometimes accurate."

As a matter of fact, what are the credentials of these self-appointed critics? What do they really know of the men they are maligning? What do they really know of the responsibilities and heartaches of the profession they damn so blithely? Not very much, I would say. Mr. T. Swann Harding, the most vociferous of them all, may serve as an example. He is described by himself as "chemist and author" and by his publishers as "one of the few lay contributors to orthodox medical journals." I would that his publishers had been more specific. I find him in many lay journals, I find him in a book of nearly 400 pages, in which our sins of omission and commission are handled in minute detail and many words, but I find him not in the medical journals which I and my friends peruse. His objections to us and our ways are perfectly typical of many of our critics.

Mr. Harding does not like it at all because we persist in believing that cancer is not inherited, whereas, he says, the bulk of scientific research proves that it is. He is opposed to the "ill-advised" procedure of thyroidectomy for the relief of exophthalmic goiter. No information, he says, can be expected from examination of the skin and eyes of a subject with "patient anæmia,"

¹Address of the Retiring President presented before the Clinical Congress of Surgeons New York October 1-16 1931

One other charge of T Swann Harding's must not be omitted. Dear to his soul, running like a leit motif through all his writing, is the outcome of certain intelligence tests in the army which proved physicians to rank in mentality only just above dentists and veterinarians, for him that places us mentally, once and for all, but those of us who emerge from the Binet-Simon test with a mental age of ten or thereabouts have a fellow-feeling for the military doctors who achieved the same results.

In short, there are a host of writers who have their quarrels with us and our performance, many of them richly deserved I admit, but who forget fairness and justice and even good breeding when they undertake to publish them to the world. Levity aside, there is no doubt that many of us richly deserve to be charged, even by such *ex cathedra* critics as these, with ignorance and incompetence. With most of us, however, the charges are relative. Most of us, honestly and without reserve, treat our patients to the best of our ability and knowledge, though ability and knowledge are necessarily variable qualities. We are human beings, exactly like the people who criticize us. We have in our ranks no supermen, no archangels, from whom perfection can be demanded. Conscienceless, unscrupulous men are just as likely to be physicians as to be blacksmiths or priests. Physicians are just as likely to make mistakes as other people, rather more likely, in fact, because medicine is not an exact science and medical art is chiefly learned in the hard school of experience. You and I know, even if the public does not, that symptoms have a disconcerting way of refusing to group themselves into categories, that physical findings have an equally disconcerting way of refusing to be classified, that the same disease appears in protean manifestations, that a diagnosis made with all the skill and ingenuity in the world may prove to be entirely wrong. Finney is quite correct when he says that mistakes due to lack of training and experience differ from the mistakes that are common to us all as human beings and that can no more be avoided in medicine than they can be avoided anywhere else in life.

The public, however, does not seek to classify physicians according to any standard of ability and training. More than that, it shuts its collective ear tightly to any endeavor, public or private, to present the true facts. It reserves to itself vehemently and emphatically the right to choose its own physicians. "Any man"—I quote Finney again—"with an M. D. degree is legally entitled to operate on any person foolish enough or igno-

rant enough to permit him to do so," and the number of the foolish and ignorant is legion. It is disheartening to realize that intelligent people do not choose their medical attendants with the degree of care they would devote to the purchase of a piece of furniture or a new hat. The public will not learn, it does not care to learn, what are the standards of medical competence. Over the radio, through the public press, in the schools, by every means of publicity which this enlightened age possesses, this organization, like many others, is attempting to tell the laity something of the standards which it should demand of its medical attendants, but our words fall on barren soil. For my own part, when I contemplate the reasoning by which people choose their doctors, I feel like saying what William III said to the crowd he was touching for the King's Evil, "May God give you better health and more sense."

The charge that people do not select the best doctors is, as you know, always answered by the counter-charge that the rank and file of them cannot afford the best doctors. Now I question that very seriously. Of course, the patient who is very poor frequently gets the best for nothing, and the patient who is very rich can pay for the best, though it by no means always follows that he selects the best, for the reason that his mental processes often seem to undergo a species of paralysis when it comes to the judicious selection and choice of medical attendants. The middle classes, the salaried groups, I admit are often hard put to make their medical ends meet, but the chief trouble, I contend, is with hospital expenses, not physicians' fees, and the two problems ought to be argued separately.

For the fees of the best physicians are frequently not only no higher than those of the mediocre ones, they are often decidedly less, both in actual cash and in the time and money saved by shorter hospitalization. I have no doubt that the enormous fees one reads of are charged and obtained in some practices, but most of us know of them only through rumor, most of us have rather flat purses. Moreover, as Glenn Frank points out, the problem of medical expense lies below the thousand dollar line, not above it. The patients who are charged large fees are usually the patients who could afford to pay even larger ones. Only exceptionally is the physician encountered who is not willing to cut his coat to fit his cloth, who is not willing to take into consideration in setting the price of his services the circumstances of the patient and the necessary—please note the word—the necessary hospital expenses. The loudest laments, in my

a disease about which I admit he knows more than I do for I never heard of it. Some doctor upon the *Baltimore Sun* sees no point to reliance upon the pulse rate in illness and neither does Mr. Harding. The treatment of the symptoms of the menopause with luminal or anybital is mere witchcraft for the menopause exhibit no symptoms. He prefers from the mountain of his obstetric experience pituitrin to ergot in the treatment of postpartum hemorrhage though in severe bleedings he remarks categorically, "no course must always be finally had to massage of the uterus to accelerate its contractions." He is opposed to the custom which he apparently believes routine of letting nurses direct treatment though he admits that doctors are so unaccustomed to therapists that their endeavors to assume charge themselves practically always end in failure. In short Mr. T. S. Anna Harding furnishes an excellent illustration of the dangerous effects of a little knowledge.

One F. C. Kelly writing in the *Cincinnati History Magazine* puns upon any pride we might possibly have in the achievements of modern medicine. According to him physicians have had nothing to do with the control of disease the decline in the death rate and the increase in longevity of mankind all of which things would have happened without them though how or why is not quite clear. Typhoid inoculation far from aiding in the control of the disease stirs up tuberculosis and heart trouble. Vaccination plays no part in the decrease in incidence of smallpox and the results in diphtheria are just as good without antitoxin as with it. Statistics are plainly beneath the writer's consideration. The use of the X-ray results in deformity and deformed offspring and anesthesia is not an unimportant blessing because more people are lulled into surgery. It is to the profit of the surgeon and their multimillionaire income than could be the case without it. Mr. Kelly does not care for surgery most of which he considers entirely unnecessary. He is at his eloquent best in discussing it. He has it on the word of Frank B. Gilbreth, an authority on human motion, that the surgeon is the last skilled of any class of laborers. The profit of this devastating business seems to lie in the fact that not a surgeon's sutures just like the others and since only one way can be corrected all the others are naturally wrong. Specialists he holds to be lemmings on the ground that a physician is incapable of discerning for himself what is the matter with a patient, but you are incapable of assessing the findings of others a point of view which demands an omniscience scarcely to be hoped for in this

very imperfect world. We are not however left entirely comfortable as all disease we are told is benefited by not thinking about it and leprosy is named as a particularly good example of this nihilistic treatment. F. C. Kelly illustrates excellently the type of mind which falls with and tumbles upon the non-probabilities. It is most of Oliver Wendell Holmes that if the whole materia medica were sunk to the bottom of the sea it could be all the better for mankind and all the worse for the fishes. For to him the practice of medicine means simply the giving of pills.

Bernard Shaw would scorn to be considered among lay journalists but the preface to *The Doctor's Dilemma* is such an excellent example of the abuse of medical men that we may well include it here. His whole theme as Leary says is based on the premise that whatever is in surgery and in medicine one gathers there are very wrong indeed. We learn from him that the tragedy of life is at present that it gives one helplessly into the hands of a profession so deeply mistrusted. Most doctors have no honor and no conscience and the truth about them is too terrible to be faced. Surgery is performed and drugs are given only for the sake of fees. Vaccination is done in filth and vivisection because of a lust for cruelty. The proportion of deaths under the Pasteur treatment of hydrophobia is rather higher than without it—statistics are nothing to G. B. S. All bacteriology is superstition and a method to prevent infection is simply played upon human credulity. A difference of medical opinion is one more evidence of ignorance and dishonesty. The rank and file of doctors are no more scientific than their tails. Mr. Harding believes that if the competent medical men who exist are to be found in the laboratories and at the heads of departments leaving the hands of the laity to the mental profligates of the profession, life is to be regarded as a possible and unaltered present system as a possible multiple and distinct. In between a quack doctor and an authorized one is mainly that the latter is legally entitled to sell the lethal certificates for which both have equal need. But here also is a gleam of hope in state medicine of which more later. Not in homeopathy, the poison the cure and the fish-medicine is medical salvation to be found.

Time does not permit the detailed mention of many other equally meretricious criticisms but I cannot refrain from calling to your attention *Chester T. Coe* who has lately the most unfortunate and most unbelievable series of experiences in hospital that ever befell him. Talma

to study its output, and, in particular, to analyze its mortality, and that the individual surgeon would do well to evaluate his personal work in the same exact manner. A striking case in point—and here, as I have done elsewhere, I pay tribute to the gallant courage which inspired it—was the fearless publication by Watson and his staff of the details of that nightmare epidemic of puerperal infection which scourged the Sloane Maternity a few years ago. Medicine is benefited and bettered by the unafraid facing of its own performance, yet one cannot refrain from wondering what the critics of the profession would make of such reports, and speculating on the mud-slinging that would undoubtedly ensue.

A woman journalist with a vitriolic pen, in a recent discussion of fee splitting, is apparently quite unaware of the compliment she pays us when she remarks that in the larger hospitals of a certain city, in which the staff is composed mainly of Fellows of the American College of Surgeons, such an abuse is not prevalent, whereas it is rife in smaller hospitals, on whose staffs are few Fellows of the College. Her intention, obviously, is not complimentary, but her remark works both ways: it is as much a tribute to the achievements of the College as it is an indictment of the Fellows who do not live up to its requirements. It would be a unique situation, for that matter, if in this special organization, composed of nearly 10,000 members, there were not, in spite of the strictest insistence upon qualifications and character, men who were not worthy, men to whom the Fellowship pledge was merely a scrap of paper. But surely that does not condemn us all.

The remedies suggested we can touch upon only briefly. Advertising obviously would not help, for the incompetent physician would blow his medical horn far more loudly than his better trained confrere, and the public would be slightly more bewildered than it is now. The group clinic, with specialists at the head of every department, with adequate laboratory facilities, and with a reduced overhead because of a businesslike administration, has much to commend it, and the clinics for salaried, middle class patients, as run by Johns Hopkins Hospital and Cornell University, have done a great public service. On the other hand, under this plan the personal relation between physician and patient, which has been, and in the opinion of old fashioned practitioners like myself, still is the bulwark of medical practice, would receive its death blow.

Health insurance works in nearly twenty-five countries, being more or less successful according to the degree of paternalism which the govern-

ment practises in its administration, but it is doubtful whether it would ever work in the United States, and it is obviously open to grave danger of abuse. Perhaps in the future some practical scheme of private insurance can be worked out. If it can, it will be a better thing than the voluntary saving against a medical rainy day which is the only recourse at present, and which stands small chance against the counter-claims of installment salesmen.

The most ardent reformers of medicine, however, pay small heed to such schemes as these. It is upon the project of state medicine that they fall with the loudest cries of joy. The profession, Shaw assures the world, will remain a gigantic conspiracy to exploit human credulity and suffering until it becomes a body of men trained and paid by the country to keep it in health. Harding, apparently forgetting the scandalous showing of the army doctors in the matter of the intelligence quotient, quotes the army and navy to prove how speedily such a scheme would usher in the medical utopia. Even Glenn Frank, whose brilliant address before the Congress two years ago is still fresh in our minds, seems to have a childlike faith that when medicine is under state control, disease will be conquered and death will be no more.

Perhaps so, but I doubt it. Why should the practice of medicine by the state herald the millennial dawn? What has happened in Russia does not fill with enthusiasm those who have seen conditions at first hand. The coroners and health officers at present in charge of our affairs are often not of a caliber to inspire us with much hope for the future. Public and municipal hospitals are filled with medico-political appointees whose ability is frequently negligible and whose ethics are frequently doubtful. One has only to look at the corruption in state and municipal governments throughout the country today to question very seriously the claims which are made for further state control of anything. The old query forces itself to the fore, what price politics?

It is consoling to know that all of our lay critics do not believe that we are headed straight for perdition. The cynical Theodore Dreiser, for instance, paints a very tender picture of a type of doctor who still, thank heaven, exists among us. W. D. Howells says that doctors are almost universally gentlemen, either because they were born so or because the Hippocratic oath has made them so, and he writes with sympathy and understanding of the failures and disappointments of the physician, who knows more evil than other men, yet who still is merciful to human frailty and who gives to mankind more even than the priest.

experience come from the patients whose hospital expenditures know no restraint and are frequently entirely uncalled for but who once discharged either ignore the physician's bill altogether or who assure him that they cannot pay it now—if ever—because of the same hospital fees in comparison to which I might add his charge is usually very small.

But the critics think otherwise. They know that all fees are high and the mere thought of an attempt to collect them throws them into true apoplectic rages. But why is it so useful for a doctor to earn his living by the practice of medicine? Why should he not try to collect his bills? Is there another branch of human endeavor in which the necessity for living by the labor of one's hands and brain is met with so much contumely and scorn? The average physician did not choose his calling primarily because he expected to become rich at it. His cakes and ale are always late in coming, and sometimes never arrive at all. Surely he is entitled to some reward for the time and money he has expended in his training and the toil and effort he puts into his practice.

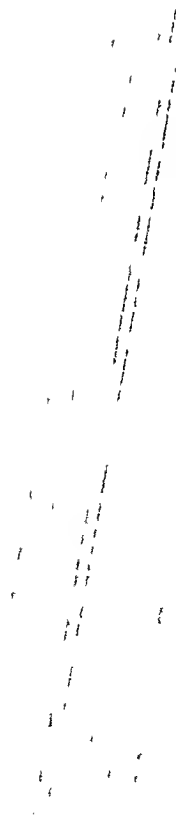
To attain the degree of ignorance and incompetence with which we are all so glibly charged it takes the doctor after his primary education from seven to nine years of college and hospital work, and it costs him from eight to twelve thousand dollars. When he begins to practice in addition to maintaining a certain standard of living he must spend from 30 to 40 per cent of his income for professional equipment and for keeping himself abreast of the medical time. He works hours that a union laborer could not be persuaded to consider for any wage and food and sleep are frequently given no mental consideration. He does each year hundreds and sometimes thousands of dollars of free work. If he is expected to contribute besides to all charitable causes. He commences his earning days late and he must stop reluctantly because of his physical limitation. His career possibilities heavier than those of the common man and Rabbin's jest is still true. There be no drunkards among us, but old physicians. His income continues only while he himself is earning it and he is very lucky if he collects as much as 60 per cent of his fees. Is there any other profession besides earth which would continue to pay a user's children hand caps? Yet contentedly and contentedly of the physician. He points out the difficulties the necessity he and his family labor under for food and shelter and clothing. The general feeling that his rewards should be purely spiritual and that he and his subsist on heavenly manna.

I say in all seriousness that I believe the moral sense of the public is steadily diminishing. It comes to doctors' bills. Persons who are honest one asumes in other walks of life regard a bill from a physician as something to be paid when they get around to it if it is ever paid at all. If the grocer's bill is not paid they get no groceries. If the gas bill or the water bill is not paid a callous corporation or a soulless city council cuts off the gas or water. If the installments on the radio and the automobile and the furniture are not paid back go the radio and the automobile and the furniture to the firms that sold them. But the physician cannot take back his services and the ethics of his calling do not permit him to refuse to treat people who do not pay him and who he knows full well never intend to pay him.

Some day the doctors may take the public to the confidence on the subject of those same unpaid bills and I predict that a number of people are going to be very much surprised. For an amazing proportion of them belong to patients who seemingly can provide themselves with all the necessities of life as well as with most of its luxuries. They have country and city homes, cars and servants. They travel they send the children to exclusive schools, they entertain lavishly. But they do not pay their doctors and they meet them publicly and socially with never a quiver. I myself have frequently lunched at a dinner in the company of people who had no other money for months and years but I myself as the only person present who was at all embarrassed.

To leave this enormous consideration it has often struck me as very curious that our critics do not seem able to interpret our own criticisms of our elc. They quote what I say of myself as a direct evidence of their blanket contentment for so things as without comprehension the healthy significance of our realization of our own shortcomings. For instance last year in this Congress I had something to say concerning competition in surgery and I find a portion of my remarks used to advertise the T. S. Annals in a book in the blurb of which I travel in the distinguished company of Dr. W. J. May. The crage lay journal completely a sun since I admit that I have faith that every thing in medicine must be on an entirely medical man must be a scoundrel. It does seem to dawn upon them that we are merely cleaning our own house that the dirt is in it of the few of them and that that is in it right and proper that it should come from within.

Another thing I have noticed lately is that the most helpful thing that any staff can do is



Stevenson's tribute to the physician as the fine flower of our civilization is too well known to need repetition and St. Loe Strachey echoes him when he says that there is no profession which is more exposed to the temptation to forget honor, humanity and kindness none in which the exploitation of human suffering is easier and yet none in which the temptation is so triumphantly withstood.

I do not think that we altogether deserve the cheap abuse, the verbose smartness that is leveled at us so often in the lay press today. On the other hand we would do well to remember as Kipling says that no shortcomings on the part of others can save us from our own. We deserve all too many of the charges that are brought against us. We know far too much science, Harding and his fellows to the contrary, and far too little of the medical art. We have too much knowledge and too little humanity. We fumble and stray when we should walk direct and straight. We fail all too often though it would be simple justice for our critics to remember that inability to cure is not necessarily a stigma of ignorance and incom-

petence. We are an altruistic and a self-destroying profession yet we are too frequently selfish and self-seeking. But we carry the poorest of us a heavy load of care and responsibility and constantly recurring disappointment which those who have not borne it cannot possibly comprehend.

Strachey in that same essay from which I have just quoted mentions a life of Hippocrates written by an American physician and dedicated

To the noble profession whose gospel is the healing of mankind whose honor is the Hippocratic Oath. That is our ideal, Gentlemen of the College even though we fail to achieve it and as I resign these symbols of the office with which you have honored me to the President who is to succeed me I am giving them as you and I owe to an honorable gentleman and distinguished surgeon who exemplifies in his life and practice this high ideal and in whose hands the destinies of this College are safe.

Vote.—I desire to present the following resolutions to the Association of Surgeons of the College of Physicians and Surgeons of the City of New York.

FUNDAMENTALISM AND SOCIAL PROGRESS IN MEDICINE¹

ALLEN B. KANAVEL, M.D., F.A.C.S., CHICAGO

THE investiture with these robes of honor brings with it a sense of humility, especially when one remembers the distinguished surgeons who have preceded him. They are accepted, however, as an expression of your desire that each and every member of the College should feel that the duties and responsibilities of membership should be shared by all, that our College is democratic not autocratic, an association not a government, the concrete expression of the ideal that the most enduring progress in social movements follows the participation of all, even the humblest, in its deliberations and activities.

In this spirit of mutual counsel, may I bring for your consideration some of the problems of the present day tendency toward the socialization of medicine with its suggestions for group and contract practice and modification of our code of ethics? In beginning the consideration, it is pertinent to ask whether we have minds sufficiently free from guild arrogance, guild complacency, and guild fundamentalism to consider wisely the basic principles. The history of medicine is replete with examples of our ultra-conservatism. In Egypt medical practice was rigidly prescribed by the Hermetic Books of Thoth and, if a patient's death followed any variation from the prescribed procedure, it was regarded as a capital crime. Aristotle in his *Politics* says that physicians were allowed to depart from the accepted methods of treatment only in case the patient did not improve in four days. The authority of Galen benumbed scientific medicine for thirteen centuries. The only question was whether the original Latin translations or that of the Mohammedan, Avicenna, interpreted the master correctly. It was not until Paracelsus came to the bonfire of the students at Basel celebrating the Feast of St. John and threw into the blazing flames his Avicenna's *Canon of Medicine*, saying "Into St. John's fire so that all misfortune may go into the air with the smoke" that the pall of Galenic authority was lifted. So Luther broke the spell of the papacy when he burned the papal Bull and Statutes by the Elster Gate of Wittenberg.

There is some justification for fundamentalism in social concepts, but none in science. Thus the Catholic Church found when it denied that the planets moved around the sun, and the faculty at Basel when it called Paracelsus a liar, a suborner, "a necromancer," "possessed of the

devil," "an ox head," and "the forest ass of Einsiedeln." Neither the imprisonment of Galileo by the Inquisition nor the banishment of Paracelsus changed the facts in the slightest degree.

Guild arrogance refused for fifteen centuries to recognize medical thought unless expressed in Latin and emanating from established centers of learning. Literature was proud to honor the English language with its Chaucer and Shakespeare, Italian with its Dante and Tasso, French with its Deschamps and Villon, but medicine clung to its Latin. Dr. Lorenz Fries, although of the Galenic school, was persecuted because he said, "Methinks German is not less worthy to express all things than are Greek, Hebrew, and Latin." The barber surgeons of France were denied professional rights because they could not read and write Latin, and even today physicians look somewhat askance at those who do not write their prescriptions in that language.

Are we yet free from the guild arrogance that refused to recognize Paré, John of Arderne, and Seigneur de Stains as reputable members of the profession? Yet Paré made Paris the surgical center of the world, John of Arderne, established surgical practice in England and maintained untarnished its ethical standards, while Seigneur de Stains, "booted lackey" as described by the physicians, ennobled by Louis XIV for curing him of a fistula-in-ano when the physicians had failed, helped to elevate French surgeons to an enviable social position. The untrammelled and unprejudiced mind is essential to scientific progress. Bacon says, "Truth is the daughter of time and not of authority." Bunyan's shepherd guides, Knowledge, Experience, Watchful, and Sincere, are for medicine much better guides than Authority, Guild Arrogance, and Self Complacency. "Medicine learned from a monk how to use antimony, from a Jesuit how to cure ague, from a friar how to cut for stone, from a postmaster how to sound the Eustachian tube, and from a dairy maid how to prevent smallpox" (Holmes). Are we now equally ready to accept and utilize new ideas whether they come from old or new centers of medical thought, whether from well known or obscure surgeons and, indeed, from within or without our profession? It was difficult for continental surgeons to believe that far removed from the wards of Velpeau, Simpson, and Semmelweis, Sims had established successful procedures for the



Allen B. Kanavos

or physicians connected with them, and not become unethical advertising? Is contract practice in itself reprehensible or is it the manner in which the practice is carried on the evil we wish to correct? Is the part-pay clinic wrong or is it the abuse of its facilities that is inimical to public welfare? The time has passed, if it were ever here, when we can decide these questions on the grounds of guild welfare. The interest of the community and the patient must be our first consideration. I am not unaware of the great dangers that threaten with any modification of our ethical laws. Unlicensed publicity opens the door for unjustified personal exploitation, for the advertising of institutions in which the returns secured depend upon the pernicious power of an unlicensed and unbridled press, and it destroys the ancient safeguard of the patient, that worth and works of the competent physician offer the safest recommendation.

On the other hand, when we see the exploitation of the poorly informed public by charlatans and medical hijackers, we must meet with constructive suggestions the desire of ethical institutions and public spirited organizations to eradicate this evil, must realize the distinction between advertising for personal and selfish ends and that for the education and welfare of our people, must acknowledge that the principle of protection of the public for which our code was established may be better served by some change in our conception of the application of our rules.

Contract practice is probably the most important question confronting us today. We recognize that it may substitute impersonal responsibility for personal, destroy individual scientific endeavor, and end in careless, hasty, and machine made service to the patient. But the necessarily high cost of competent medical service, the proved value of the association of able trained specialists, and the necessity for well equipped hospitals and medical centers for the proper study, diagnosis, and treatment of disease present problems not easily solved under our established system of individual service.

Social science and the expanding conception of medical service are leaping ahead of us, somewhat bewildered, hardly knowing what they require, earnestly anxious for help. If we do not help to solve the questions of competent, reasonably priced service, ill advised, poorly conceived, and unfortunately executed methods of service will be forced upon us with disastrous results to the public and the profession, and we will find ourselves like King Lear roaring at the storm, bareheaded and helpless.

We must begin our thinking by eradicating from our minds all thought of guild consciousness or personal aggrandizement, and ask ourselves how we can bring to all patients competent, reasonably priced service. We cannot deny that part-pay clinics may be advisable in certain instances, that contractual relations with institutions or organizations may at times secure the best service. It is the abuse of these that we must guard against.

It behooves us to give careful consideration to this so called contract practice and not because of the fetish of a name, compel organizations of individuals, industry, and institutions to employ incompetent individuals for service. Neither the individual, industry, nor the constituted authorities of government wish inadequate service, yet through the urge for reasonably priced medical attention this catastrophe is liable to occur unless, with broad and unselfish vision, we help to guide the movement toward collective medical service rather than sit complacently by, bulwarked by a supposedly sacrosanct code of ethics, and let the initiative slip from our hands.

Because of its contact with medical practice in every part of the United States, the American College of Surgeons is particularly equipped to study this question. It touches in an intimate way daily surgical practice in every state, and every form of social and industrial life.

When Pennsylvania, Rhode Island, Tennessee, Vermont, and Alabama pass compensation laws limiting payment to one hundred dollars and Kansas and Kentucky to two hundred dollars for medical and hospital attention to injured employees, we know it ends in incompetent service, but on the other hand, we must not forget that Connecticut, Idaho, Illinois and other states grant reasonable compensation, and that an industry in South Carolina has established a contract service for its employees that has secured commendation alike from physicians and patients. Side by side in Oregon flourish commendable and censurable experiments in industrial medicine.

The College was not born with a caul, so cannot be clairvoyant but must depend upon intensive study of the problem. It should not make its decisions based upon protection of a local group, but upon the sweep of the broad flowing stream of social medical service, and never lose sight of the principle that its actions must be based upon what will ultimately redound to the real service of patients. With our organization we should be able to gather all available data as to state laws regarding compensation, as to all types of contract practice established by industry or organizations and to evaluate the results of these in terms

cure of vaginal fistula Mott had ligated the innominate artery and a backwoods surgeon of Kentucky had removed ovarian cysts. I am not certain but that at the present time there is still some lingering thought that the Allegheny or the Mississippi river is the natural scientific border of the United States. If we are to exercise good judgment and initiate constructive action in the consideration of modern social tendencies in medicine we must avoid all the artificial limitations of guild fundamentalism.

Of late there has been an insistent demand for a greater socialization of medicine with some modification of our code of ethics and attitude toward publicity contract practice part pay clinics and group associations formed to give medical attention at a minimum cost. Some say that medicine as now practiced is ready for the museum of social institutions.

In contrast to this it is urged that those who emphasize the defects of modern practice are blind to the defects of socialized medicine with its benumbing of that initiative which produced our Pasteurs Kochs and Hunters our Orlers Mayos and McDowells with its deterioration of the personal into impersonal relationship with its sterility in human sympathy that shrivels the generous instincts of society and makes out of medicine a soulless machine. It is said that our age is already too mechanistic and if we continue we shall replace beauty love generosity and all the attributes of individuality with a hard cold and aspirationless mechanistic society concerned only with the privilege of gain born the duty of living and the inevitability of dying.

Conscious of our own pure ideals knowing our constant improvement in the application of knowledge to the cure and eradication of disease and filled with pride at our discoveries and the advance in medical science we are surprised that an enlightened public dares to question our methods of practice and we unhesitatingly resent any attempt to challenge them. The day of such comfortable thoughts is over. The swelling unrest of modern society has caught us unprepared to meet its demands. Judgments asked to function where the conditions fit at least favorable. The educated man sees the possible pitfall of any change—he wishes to stop look and listen to accept change only after careful and after troubled consideration but the tempo of modern society demands quick decisions whether right or wrong. Thus we find ourselves instead of guiding the changing conception of medical service dragged at the chariot wheels of reckless ill informed doctrines and social reformers.

One cannot help but hope that from these two conflicting views will come some constructive thoughts that will meet the exigencies of modern life and yet retain the ideals of medicine the personal relationship of physicians with the unfortunate sick and permit the unhindered progress of medical science. This is one of the great problems to be met by the American College of Surgeons and it must be met by you younger members of our organization. In affiliation you resolve with us you have accepted our responsibilities as well as our privileges and to you particularly will fall the solution of this question in the years that are to follow. You will fail if you do not stand blind attachment to old principles unthinkingly venerating for tradition and do not recognize the fluidity and provisional nature of medicine in its relation to society. Such change will come probably not as a perfected plan of procedure but as

an hypothesis in action modified by the experience it adduces. Guild isolation must cease. We must not like the Pharisees set ourselves apart with broad phylacteries upon our brows. A knowledge of the attainments of modern scientific medicine must not be the peculiar birthright of the physician but must become a part of the common heritage of the every day citizen. Far from retarding the inquiry of the public as to our aims and ideals we must welcome the association of the constructive mind of the well informed laymen in the solution of the great problems of the application of our discoveries to the benefit of mankind. Our medical schools must be training centers for public service racism must be based not on the trade union concept of preserving our rights and maintaining our guild superiority but upon the premise that when we serve the public directly we serve ourselves best.

Twenty centuries have established certain principles of professional conduct and medical practice and we have embodied these principles in a code of ethics. But is this legal possession of moral and ethical conduct sacrosanct? Ethics and morals do not change but our interpretation of them as applied to social conditions must vary with changing conditions. Into our social structure we have come many startling changes in the last decade and it is pertinent to ask whether some modification of our concepts of ethical practice may not be necessary to meet these changed conditions. The public reverts decisions as to professional conduct made upon technical interpretation of our code and has rightly demanded action based upon the broad principle of public welfare. How far may education of the public go as to the standards and service of institutions

PRESENTATION OF HONORARY FELLOWS

FRANKLIN H MARTIN, M D , F A C S , CHICAGO

AT the Convocation on Friday evening Honorary Fellowships were conferred by the President on the following eminent surgeons

PROFESSOR DOCTOR HANS VON HABERER, Cologne, Germany, an alumnus of the Medical School, University of Graz, Geheimer Hofrat Professor, Doctor of Medicine, Distinguished Surgeon, Clinical Professor of Surgery, University of Cologne, Director of the Surgical Clinic, University of Cologne Introduced by Dr Frederic A Besley

PROFESSOR ARTHUR HENRY BURGESS, M B , F R C S , Manchester, England, Distinguished Graduate and Professor of Clinical Surgery of the

University of Manchester, Senior Honorary Surgeon to the Manchester Royal Infirmary, Consulting Surgeon to the Christie Hospital for Cancer, Manchester, Past President of the British Medical Association Introduced by Dr George W Crile

SIR CHARLES GORDON-WATSON, K B E , C M G , F R C S , London, England, Eminent Surgeon, Graduate and Joint Lecturer in Surgery, St Bartholomew's Medical College, Surgeon to St Bartholomew's and St Mark's Hospitals, Consulting Surgeon, Metropolitan Hospital, Member of the Council, Royal College of Surgeons of England, Ex-President of the Aesculapian Society Introduced by Dr George David Stewart

PRESENTATION OF CANDIDATES—CLASS OF 1931

FRANKLIN H MARTIN, M D , F A C S , CHICAGO

IN behalf of the Board of Regents of the American College of Surgeons, I have the honor to present to you, Mr President, candidates for Fellowship in the College, as follows

United States	619
Canada	7
Alaska	1
Hawaii	4
Philippine Islands	1
Australia	1
China	1
England	1
Guatemala	1
India	1
Mexico	2
Peru	1
Siam	2
Total	642

Inasmuch as the candidates before you have fulfilled all of the requirements for admission to Fellowship, and have affirmed the Fellowship Pledge of the American College of Surgeons, on authority of the Board of Regents of the College, I take great pleasure in presenting them for Fellowship

Each year as we receive a new class of candidates into Fellowship I am impressed by the prestige of an institution that can influence such a

goodly number of busy practitioners of surgery to seek its portals

To the casual observer these men appear as one more group that is being enrolled into our ranks. Complacently, this observer shrugs his shoulders and reflects "How easy!"

As an illustration let us enumerate the facts. There were 4,388 applications for Fellowship on file January 1, 1931. Seven hundred and nineteen of them were already approved by their state or provincial committees on credentials, 1,490 were presented to state and provincial committees on credentials during this year. Of these, only 640, or 45.5 per cent, were approved and recommended for examination. Of the total recommended for Fellowship before and since January 1, 1931 (1,359), our careful sifting process has admitted to Fellowship only 642, or 47.2 per cent, constituting the candidates who are here present.

Surely if we pay tribute where tribute is due we must pay full portion to the magnificent group which is before us this evening. Veritably they are the survival of the fittest.

They are to be congratulated, and the College is to be congratulated, but above all, we must congratulate the people who shall in the future seek their services.

of service to the sick. Thus we should be able at least to guide the trend of medical socialization.

Statesmanship consists in having the capacity to evaluate ideas. The doctrinaire with his formula worship the social reformer with idealized concepts uncrystallized by the fire of experience and industry with thoughtless materialism enunciate plans of medical service and it is the part of physicians who deal with the problem daily to evaluate them not with prejudice self consideration or guild consciousness but with unselfish statesmanship.

Guild consciousness on the one hand and an appreciation of the dangers of communistic medical care on the other make us hesitate in recommending changes in the practice of medicine. We must not forget however that we take pride in the free public school system of our country that the teachers are devoted and progressive and no one would dare to question that the general education of our people has been a profitable social experiment. It is equally true however that the presence of non public institutions endowed by a generous public working side by side with our public schools has been an incentive to better work often indeed the non public institutions have initiated advantageous changes and more progressive policies in our methods of teaching.

With this successful example of social service before our eyes in the every day life of our people we should not be unbending in our opposition to some modification of our system of medical practice that will insure equally to the indigent the man of moderate means and the wealthy competent diagnosis and treatment and yet retain the self respect of all. The physicians in charge of any such public service must receive compensation commensurate with the years of study necessary to the adequate preparation for the practice of medicine. If we judge by our experience with our public school system with any public service must go private institutions and private practice if we are to maintain the high standards of medicine and insure the continued advance of the frontiers of medical knowledge.

Eighty years ago we should have asked Should medicine ever fulfill its great end it must enter into the larger political and social life of our times. The solution of the problem of the absorption of medical service into the life of our people must come with the combined assistance of industry labor physicians and the public but the initiative should come from the medical profession and particularly its organizations as the American College of Surgeons hopes to serve disinterestedly the elevation of medical service.

The economic world today is in the midst of a great antisocial upheaval the end of which is either constructive action or world disorder. So far there has been more drift than direction. It demands upon those whom intelligence has made leaders more humility and less arrogance and upon those who are less favored more rationalism and less theory but the materialism of conflict factors is so vast that one questions whether social engineers can be found able to guide the turbulent stream into orderly processes.

That the medical profession however has not been unmindful of its public duty and has not failed to advocate and establish new principles the professional care and medical education of the public is proved not alone by the free service we have given our hospitals and medical institutions but by the initiation and support of such movements as infant welfare medical social service studies of the cause of the miasma by our associations for the prevention of blindness tuberculosis and heart disease by our campaigns to lessen trachoma venereal disease and the deleterious effects of age by our interest in proper housing prenatal care instruction of expectant mothers the education of the public in combating the spread of contagious disease the yearly health examination rural medical service juvenile delinquencies and the inspection and instruction of school children.

Temporarily capital may provide medical service more adequate than the unimproved laborer can secure medical protection associations may give service more cheaply states may establish legal restrictions limiting the spread of disease or provide institutions and free care for the citizens but these are only steps in a social development educated care of the people as well as the political or permanent social movements can go no farther than public education. The doctrinaires and the social reformers have their place but it is educative and not legislative. The public will not be satisfied with less than personal service in illness and the profession will we may be sure meet the demands of a changing concept of competent medical service within the reach of all.

In the solution of these great problems you as members of the American College of Surgeons must take a prominent part. As your guide may I suggest the following aphorism:

The justification of any medical organization lies in the unselfishness of its ideals its achievements come from its initiative and freedom from guild fundamentalism and its permanence rests upon its service to the public.

THE PROGRAM OF THE COLLEGE AND THE INITIATES' RESPONSIBILITIES¹

ALLEN B. KANAVEL, M.D., F.A.C.S., CHICAGO

NO more pleasing duty can fall to one than that of officially welcoming into fellowship the initiates of the College. Out of 1,359 applications for fellowship already approved by state and provincial committees, your group of 642 or only 47.2 per cent of the total has been selected as worthy of membership, attesting the care exercised by the authorities of the College in selecting its fellows. Accredited after careful consideration by your state and provincial organizations, chosen after painstaking analysis of your actual results in the practice of surgery, and approved by the Board of Regents only after grave deliberation, you may justly take pride in your induction into fellowship. With it, however, must come a realization of your responsibilities.

Eighteen years have now elapsed since the organization of the College and we may well pause to pay tribute to that distinguished group who inaugurated and has largely directed the policies of the College during its formative years. No one acquainted with American surgery would dare to say that the development and ideals of the College could have been trusted to abler hands when we recall the names of its first ten presidents, Finney, Crile, William Mayo, Armstrong, Deaver, Cushing, Ochsner, Charles Mayo, Matas, and Chipman. These, with Murphy and Martin, have had a large part in the development of the College during its formative years.

Three of these rest in honor, Murphy, Ochsner, and Deaver. Murphy performed the first appendectomy in America, invented the Murphy button for intestinal anastomosis, performed, among the first, suture of blood vessels, and made other highly important contributions to our knowledge of the surgery of the bones, joints, nerves, and lungs. He was ennobled by the Pope for his service to humanity, and decorated by several of the great powers of Europe and Asia for his service to science. Ochsner was one of the first in America to emphasize the value of the microscope to the surgeon and to correlate tuberculous glands of the neck with tonsillar infection. What Pare did for Paris, Billroth for Vienna, Lister for Glasgow, Edinburgh, and London, Ochsner with Murphy and Senn did for Chicago, making it one of the greatest clinical centers of the world.

The American College of Surgeons in honor of Murphy has erected in Chicago a great memorial

building to further its activities, and in honor of Ochsner has established a department of clinical research. In the future other marks of our respect and admiration should be associated with the names of our distinguished founders.

You have now been inducted into fellowship with these leaders of our profession. You have been chosen as representing the advanced surgical thought in your various communities. Whatever honor this induction may signify, it imposes greater demands upon you for service. You may well observe the law subscribed to by the surgeons of England over five centuries ago, namely, that no member "of the said craft of surgery" is to "put any man out of his cure" otherwise than the honesty² of the craft will,⁴ but that each of them be ready if need be or by any of the parties called thereto, then honestly³ to help each other with counsel or deed, that worship, profit, and honesty of the craft and helping of the sick be done on all sides."

Your organization is one devoted to self-criticism and self-improvement. Nowhere will you find that the College has arrogated to itself judgment upon the acts of surgeons or organizations outside of itself. We have, however, dared to say that after careful survey and study we believe certain surgeons and institutions are worthy of public confidence and trust. Any authority we may have has followed from the sincerity and honesty of our purpose and actions. To you has been bequeathed this great heritage of public and professional confidence. You will be watched with jealous eye and the failure of anyone of you to conserve the ideals of professional honor, of service to the public, and of self-improvement will impair more than you realize, the prestige of the College.

By a study of reports available to you through application to headquarters you should acquaint yourselves with the past activities and accomplishments of the College since, in the few moments at my disposal, only the barest outline of the work of our distinguished director general, his associates, and the various committees, can be given. These accomplishments have found expression,

¹Steal his patent from him

²Honor

³Allows

⁴Honorably

CASE HISTORY—HONOR LIST AND PRIZE AWARD

ALAN B. KANWEL, MD, FACS, C

SURGERY GYNECOLOGY AND OBSTETRICS—the official journal of the American College of Surgeons—acknowledges a deep obligation to the College. Two of its fundamental activities have materially increased the value of contributions to medical and surgical literature. First the standardization and amplification of case records in the approved hospitals of the United States and Canada and second the recognition of the College which requires as an evidence of qualification for Fellowship the filing of one hundred case records of operations actually performed by the candidate.

I wish every friend of the College could peruse the sixty-five thousand individual case records filed this year by this group of successful candidates here before us. The judicial and painstaking examination of those sixty-five thousand records by the group of volunteers who are selected from among the teachers of surgery and the specialties in the medical departments of the four universities of Chicago could be an inspiration to any observer. Each year the quality of these records has improved until now after eighteen years of effort many of them are veritable volumes of literature of the most acceptable type—mechanically artistically and scientifically.

SURGERY GYNECOLOGY AND OBSTETRICS in 1930 asked the privilege and the request as cheerfully granted by the Regents of presenting an annual prize in the form of a life Fellowship in the American College of Surgeons for the most acceptable set of case records presented by the

candidate during the preceding year. The prize consists of Five Hundred Dollars invested in the name of the successful candidate for life dues in the American College of Surgeons and is accompanied by an appropriately engraved certificate of appreciation on behalf of the donor SURGERY GYNECOLOGY AND OBSTETRICS. The prize winner last year was Dr. James T. N. of New Orleans.

The Committee in seeking the prize winner from among the successful candidates before you selected five outstanding sets of records which constitute an honor list. May I ask each honor man to rise as his name is read?

Ch	I	T	I	B	H	gh	m	W	h	g	t
D	y	B		f	M	g	t	w	W	t	g
R	C	G		f	B	t	M	as	ch	t	t
H	Id	A	F	I		P	t	M	h		
H	H	O	l	f	S	A	t	no	Tes		

And now may I announce the prize winner from among this group and invite him to the platform to receive the certificate of appreciation from our official journal and the formal receipt for life dues in the American College of Surgeons.

Will Dr. Ogilvie please come to the platform?

Dr. Ogilvie this recognition of your work is a possession by the College of its belief that scientific investigation, careful records and critical analysis of case histories elevates the standard of surgery and is due to patients the most efficient care. It is our hope that this possession of commendation may serve to stimulate others to emulate your example advance the frontiers of surgical knowledge and benefit those entrusted to our care. I congratulate you.

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¹Presidential Address presented before the Convocation of the American College of Surgeons, New York, October 1-17, 1931

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Chas. T. Telford, M.D., West Virginia
 Drs. Y. B. R. and M. R. G. West Virginia
 J. G. C. G. and B. T. M. S. Chas. T. Nix
 H. D. F. J. G. J. P. J. M. H. W. A. T. S.

And now may I announce the prize winner from among this group and invite him to the platform to receive the certificate of appreciation from our official journal and the formal receipt for life dues in the American College of Surgeons.

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surgery, to make available in every community honest, competent surgical service, to establish university ideals of diagnosis and service in every hospital, and to bring to every surgeon the opportunity for self-improvement. We have endeavored to make every hospital a post-graduate school. Our staff conferences have fostered the group study of results, thus emphasizing the necessity for better preliminary diagnosis, more judicious consideration as to the necessity for operation, more care as to the choice of surgical procedure, and more painstaking attention to those intrusted to our care. These conferences have engendered mutual helpfulness instead of competition, open acknowledgement of failures, and staff study of the means to avoid them. The surgeon is no more an individualist, but an active member of a scientific staff-faculty, assuming with others a mutual responsibility for scientific, competent, and kindly care of the unfortunate sick.

The study and tracing of infections to their source, the group consideration of complications, and the verification of diagnoses and analyses of fatalities by postmortem examinations, has increased our knowledge and insured to patients better care and better prognoses.

The insistence upon adequate records has resulted in the more intensive study of the patient's disease, insured fewer unexpected complications, and lowered the mortality rate. This scientific staff activity has resulted in better training of internes and stimulated the aspiring surgeon to seek his training by assistantship to competent men rather than to acquire his knowledge by incompetent surgery upon a confiding public. From this intensive study of disease, availability of adequate records, and the facilities afforded by the College through its literary research department and circulating package library, the literature of medicine has been enriched by many valuable contributions, and, equally important, the surgeon has been stimulated to keep informed as to the advances of medical knowledge through constant reading of current literature.

Our district clinical meetings have increased our knowledge of local problems, helped in the educational program, and shown that equally good surgery is done in every part of the country.

Supported by the fellows, our commissions for the study of sarcoma, cancer, fractures, traumatic surgery, technique, and the problems of surgical research have not alone advanced medical science, but also secured for patients better treatment, less disability, and longer life.

The College of Surgeons makes no claim to being the only activating force for better medicine

and better surgery, but that it has inaugurated many movements for better and more ethical service, stimulated the whole profession to higher ideals, and done much to advance the frontiers of surgical knowledge and to insure patients competent care, no one can deny.

This brief survey of the activities of your College should not be ended without some consideration of its interest in public education. Charlatanism is not a modern evil. In the 17th century quacks pretended to remove stones from the head to cure insanity. Jonna Stevens' recipe for the cure of stone, consisting of a mixture of egg shells, garden snails, swine cresses, soap, and other ingredients, was purchased for the public by act of Parliament for five thousand pounds. In some of our states today the number of pseudophysicians equals the number of those practicing scientific medicine. Conscious of our own rectitude, engrossed in the joy of scientific investigation, proud of our guild accomplishments, we stand astounded that our worth, sincerity, and scientific attainments are not universally acknowledged, that the faith healer, cultist, and quack share with us, even in small part, in the confidence of the public. With outraged feelings we threaten to expose and fight them. I suggest that the only effective measure to combat these evils is found in the education of the public as to the principles of scientific medicine and its victories over disease.

In extenuation of our failure to accomplish this it is urged that the advancement of science is not news, that the translation of the discovery of a new bacterium or a new serum into its effects upon human life and its benefits to society is as difficult to the average man as the proper evaluation of Einstein's theory of relativity is to most of us. But I question whether more dramatic pictures can be drawn than those portraying the advances of scientific medicine. How often have we reminded the public of our victory over the plague that lifted a paralyzing horror from the civilized world, that black death which carried off one-fourth the population of the civilized world, broke down all restrictions of morality, decency, and humanity, while ghouls slunk through the deserted cities afraid to rob even the putrefying bodies that littered the streets (Garrison).

How often have we paid public tribute to Gorgas, Lazear, Reed, Carroll, and Agramonte and recalled the ravages of yellow fever that in our own day devastated our cities, paralyzed industry, established shotgun quarantines in our southern cities, and left the whitening bones of thousands as mute evidence of the brave but futile

first in the maintenance and elevation of professional ideals second in service to the public and third in the advancement of surgical science

Ideals are not intangible when expressed in action and the American College of Surgeons has demonstrated their applicability to medical service. Division of fees is not a new evil engendered by modern commercialism. In the 12th century the school of Salerno required of the applicant for it license to practice surgery that he must swear to be true and obedient to the society, to refuse fee from the poor and to have no share of gains with the apothecary. That the determined opposition of the College to this evil has elevated the standard of service conserved our self respect and commanded the confidence of the public is no small part of our contribution to surgical practice.

Our insistence that proper diagnosis must precede operation that complete service out-weigh personal consideration and that restoration of physiological function is essential to good surgery has elevated the ideals of practice. Our hospital staff conference with its open confession of error and helpful fraternal advice has made the surgeon desire more the commendation and respect of his discerning fellow surgeons than the approbation of the uninformed public.

Our inter American activities have served not alone to cement the professional activities of the United States with South America Canada Mexico and its contiguous republics but also we dare hope have fostered the cultural and political associations of the Western Hemisphere.

Our service to the public has found expression in concrete accomplishments.

To meet the need for nursing of the sick the Knights Templars lined the road of the Crusaders to Jerusalem with hospitals but the supplicants found and fewer nestled ards recorded by history attest that something more than religious enthusiasm is necessary for competent care of the sick. At a later period Dickens Saury Camp caricatures the English nursing home and all caricature that has lived has had a germ of truth. That hospital service in our own day has taken pace with the advancement of medical science is attested by the fact that sixteen years ago your College instituted a survey of hospitals and established a minimum standard of service which an institution should attain to be recognized as competent to care for the sick. It is astounding to record that simple as was this standard only 89 out of 692 hospitals of one hundred beds and over could meet the requirements. During the ensuing sixteen years at an annual expense of over twenty

five thousand dollars the College has maintained a department of hospital inspection and assistance. By education of hospital boards physicians and the public the evil has been corrected and our last report shows that 93 per cent of these same institutions have reached or surpassed the standard. Equal improvement has been secured by similar surveys extended to small hospitals. We have educated the public to realize that something more than good intent on religious atmosphere and bricks and mortar are necessary to care for the sick that hospitals must be equipped with chemical and X-ray laboratories with dietary social service and other essential departments. We have educated boards of trustees to recognize the necessity for proper equipment and adequate service to assume a mutual responsibility with the superintendent and medical staff to attain this end and to take pride in the fact that they are maintaining not a simple nursing home or custodial institution but a modern hospital and social medical center devoted to competent care of the sick, the elevation of ethical standards and the advance of medical science. Our studies of the cost of medical care proper and economical construction of hospitals simplification and standardization of hospital supplies and equipment have supplemented and aided their campaigns for better institutions.

By our assistance upon proper equipment ethical service better record more careful study of patients we have uprooted the medical staffs of the more so-called institutions in the endeavor to bring to their communities the same competent ethical service attained by university hospitals.

Our yearly report of accredited hospitals and public meetings have informed the public as to the competent care can be secured and thus the pride of communities in the local institutions stimulated interest in scientific medicine and educated the people as to the utility of charitable medical faith healing and cultism.

Our surveys as to the career of employees in industry in estimating compensation laws and co-operation in industrial studies of accident insurance setting up of medical organizations and study budget for better material aid in the adjustment of the educated questions so vital to industry insurance companies and most of all to the injured.

Important as have been these contributions to public welfare they are insignificant compared with the achievements in the elevation of surgical science and the application of medical science it has been our ambition to form a carpentry from



endeavor of the French to build the Panama Canal that now through the unselfish devotion of these physicians permits untrammelled commerce between the Atlantic and Pacific with its beneficent influence upon the amity of nations

How often have we told our patients of Pasteur and Lister whose researches opened the door of hope to the tens of thousands suffering from surgically curable diseases and do we mention the scientists who removed the hand of death from tuberculosis syphilis diphtheria diabetes typhoid and cholera and many other great enemies of health and society?

The great dramatic story of the modern conquest of disease may be told ethically modestly and honestly and yet by its recital confirm the confidence of the public in the scientifically trained physician

The American College of Surgeons regard the education of the public as to scientific medicine an official duty and your personal obligation

On behalf of the officials of the American College of Surgeons I welcome you to this fellowship of ideals in self improvement in the advancement of the science of surgery and in service to the public

THE LAITY AND THE PROFESSION OF MEDICINE¹

JAMES R. ANGELL, PH D, Litt D, LL D, A M, NEW HAVEN, CONNECTICUT
President Yale University

I COUNT it a great honor to be chosen to deliver your Fellowship Address upon this occasion, which in other years has been graced by so many distinguished men, not a few of them famous surgeons from abroad. And I may claim some slight right to be in this distinguished company, despite my lack of an M D degree, for several eminent surgeons of your group have, at my anatomical expense, extended their knowledge of the obstinacy and eccentricity of the human frame. As a layman, I do not presume to speak on technical matters, but I do propose to discuss briefly, and upon your sufferance, certain aspects of medicine in which the layman and the doctor have a common interest.

Medicine is the one profession whose controlling purpose is to make itself more or less unnecessary—in other words to commit suicide. Not that any such result is imminent in this generation, but that it may well approach realization in the not remote future, and, in any event, that the nature of the profession and its main business may easily take on quite a different aspect from that which we know today. The extraordinary ascendancy which has been gained over many of the more devastating of communicable diseases, the definitely advancing mastery over many menacing organic and metabolic diseases with surer and earlier diagnoses, the dramatic developments of a thousand kinds in surgery, the widely successful public health measures in their control over water and food, the slow but steady spread of sounder notions of hygiene, both physical and mental, including a far larger devotion of time and interest than formerly to wholesome outdoor sports give us, on the far horizon, the vision of a day when the sheer bulk of human bodily ailments will be enormously reduced. What eugenics may do to breed out poor strains and so further diminish needless human misery, no one can predict, but it is unthinkable that reasonable, but drastic, measures will not be found to curtail the number of births of the seriously unfit, to say nothing of controlling births in excess of the possibilities of a well conditioned population.

But, in the meantime, it may not be unbecoming in a layman to raise a slightly protesting voice against the deluge of criticism poured out upon the medical profession (not a little of it emanating from medical men) and to insist that the pub-

lic has a vital interest in seeing to it that, while abuses are abated, the essential value of the physician and surgeon to the community is not crippled by dubious restrictions, and that the circumstances of medical practice are not made so unattractive, both financially and professionally, that the quality of the men drawn into the profession will suffer. There is no profession in which it is more important that men of the highest intellectual and moral caliber be recruited, for even the most materialistically minded doctor has now and again to perform the functions of the priest as a cure of souls, and, as such, he must be both wise and sympathetic. He will if successful be of necessity something of a practical psychologist, for men's minds are of the essence of their personality and it is always the person who is sick, and not simply his heart or his liver—or even his pocketbook—and if he comes into conspicuous position of large power the physician will also need all the resources of the most skillful and judicious statesman. Moreover, the common daily duties of his professional routine demand for their effective discharge the devotion of trained intelligence of a high order.

Because of these considerations and many others like them, it is in the deepest interest of the public to exercise caution in any compulsory methods designed to bring about changes which, although apparently desirable, may carry in their train consequences far more evil than those they were devised to correct. Human experience is full of such lessons. You bring in parasites, birds, and animals to destroy some pests which menace crops, and in the end your relief forces may do more damage than the foes they were introduced to exterminate. In medicine itself, we have in the United States had a striking instance of what may occur under similar conditions. We elevated the standards of our medical schools so widely and so fast that we drove out into schools of faddists, many of them probably outright fakers, large numbers of students who would otherwise have gone to the weaker medical schools. Indeed, new cults sprang up and forthwith organized schools chiefly to exploit this situation. Which is the greater evil, the present or the earlier conditions, I do not pretend to say, but the result of our well intentioned effort has been far from unequivocally good and certainly very different from our antici-

¹Fellowship Address presented before the Convocation of the American College of Surgeons, New York, October 16, 1931.



Samuel R. Angier

appears to be exploiting men for the promotion of merely financial and material gain. A good deal of it suggests the ideals of the *New Testament* and the teachings of the Carpenter of Nazareth. The repercussion of this philosophy is felt wherever men believe that they are overcharged for necessary services, or given inferior service when they require the best. This applies to transportation, to food supplies, to sundry forms of business and industry, to the maintenance of health, and to many other interests. Its motives are intrinsically humane and no thoughtful person can view its development without deep sympathy and the prayerful hope that, in its enthusiasm for a nobler and finer humanity, it may not blunder and fail by seeking, at a single step, to gain the *Utopia* which must be won, if at all, by slow and painful effort.

We should not be terrorized, or stampeded, by a mere name. The socializing of medicine, for example, may mean much or little. It may menace the profession, or it may be its salvation. Of one thing we can be sure, and that is that, in the long run, by hook or crook, society will command competent medical and nursing service, adequate in amount to meet the needs of everyone. If it cannot secure this as the result of measures voluntarily devised and perfected by the profession and its interested friends, it will look to other agencies, and notably to the government, to produce the desired results. With political methods and conditions what they are now in the United States, it is difficult to contemplate such a solution without the gravest misgivings.

On the purely financial side of the problem, there are certain observations that should in fairness be made. Despite the exploitation of the very rich by certain of our fashionable medical men, and despite the excessive fees charged by others to patients who cannot afford to pay them, there is equally no question that most doctors do a large amount of essentially gratuitous work and that the average practitioner has a very modest income. Indeed, I am disposed to agree with Mr. Filene, who, in a recent paper, declares unreservedly that the competent doctors are seriously underpaid, and, at the same time, asserts that the public has to pay far too much for the service it gets—two seemingly contradictory propositions which he attempts to reconcile on the ground that the doctors, as a profession, have not developed genuine business insight and ability, and that until modern business methods are employed, the present sources of friction will continue.

The medical fraternity as a whole is apparently disposed to stress predominantly the im-

mediate financial disadvantages to the practitioner of many of the changes now under discussion, fearing not only that his none too adequate income is to be further curtailed, but also that he is to go the way of much small business and be swallowed up in some great machine organization. There may be basis for this fear, but to my lay mind the far greater ultimate menace which the community has to face is the loss of certain other intimate and more personal values, which I wish in a moment to stress. Ultimately, the economic difficulties are fairly sure to be equitably adjusted. It will be immensely more difficult to protect and restore, if once lost, the familiar elements which I wish presently to emphasize. It is unusual for me to find myself in any sense on the merely conservative, or stand pat, side and I am not so in this case, so far as concerns the remedy of essentially bad conditions, but I am solicitous that the remedy applied be not worse than the disease.

While the virtues of the old family physician, with his historic black bag and his one horse chaise have perhaps been sentimentalized rather out of relation to reality, nevertheless he did represent an invaluable element in medicine and it will be tragic if, with all the inevitable changes which have come to pass, many of them so profoundly beneficial, and with the more drastic ones which are certain to come in the future, we cannot devise a way to restore, or retain, an appreciable part of these virtues, which were, in the last analysis, keyed to direct human relationships of friendship, knowledge, sympathy, and respect.

As I survey the general drift of the considerations to which I have drawn your attention, there are certain conclusions of which I feel sure, because they touch matters of fundamental psychology, in which I am bold enough to entertain a definite opinion. I am thus confident that any measures which substantially lessen the interest of the physician in his patient as a man, of whose personal and social status he has some direct and sympathetic knowledge, are materially detrimental, both to the patient and to the doctor—and so to the social order of which they are both members. Again any measures which seriously lessen, or outright rob, the physician of the urgent incentive to excel and to go forward steadily and rapidly in his profession are quite as much a loss to the community as to the doctor. Any measures which deprive him of reasonable economic reward for such excellence as he possesses—reasonable in terms of other social services requiring comparable responsibility, training, experience, native ability and skill—are a grave detriment to all

patrons. Again our physicians have generally pooh poohed the bearing of the mind on disease as a matter of definite scientific medical treatment and overnigh freebooters by the thousands spring up to exploit the genuine market so created.

We are all familiar with the common lines of attack on medical procedure. We know that the United States has approximately twice as many doctors in proportion to the population as England and Germany and nearly four times as many as Sweden. We know that despite this fact the supply of medical service to rural areas is grossly inadequate and that even in the cities a large amount of serious illness constantly occurs without medical aid. We have reason to believe that approximately 6 per cent of the population at any one time incapacitated by illness and that probably 250,000,000 working days are each year lost by illness not a little of it wholly needless. We know that while the average family medical bill per annum is roughly one hundred and twenty dollars the charges for many families are far above this and that more often than not they fall where they can least well be borne and are coincident with a loss of income partial or complete. We know that some medical men are ruthless in their charges for services making Shylock look like a pure philanthropist that fee splitting still goes on that needless operations are probably useless but expensive treatments are ordered by some surgeons and physicians that the shyder is abroad in the land and that the patent medicine business is still flourishing thanks largely to human credulity human imagination and the assistance of a sometimes venal press. We know that so little educational work has been done that preventive medical measures are little appreciated and often poorly supported. For example four fifths of our rural counties have no organized health service at all. We know that doctors are by no means as yet unanimously concerned for the health of the general community as the responsibility and that they are often unimaginative and obstructive in their attitude toward the development of a competent personnel for public health work. We know that hospitals despite the large number of free beds remain a majority of them can not care for all community needs and that the few exceptions if they comply with proper medical and nursing requirements they are operated with the utmost financial difficulties. We know that our medical training leans much to be desired that the young doctor brought up in a hospital internship where skilled nursing and every scientific facility is immediately at his hand may

be ill prepared to face the exigencies of practice where he cannot have access to these aids. We know that this same type of training tends to stress interest in the special disease rather than in the patient as a human being. We know that the training of specialists is in many respects grotesque and that the financial temptation is set up as a special despite the lack of suitable preparation for many young men irresolute. We know that hospital should be schools for the continuation training of physicians and that a yet such is rarely the case. We know also that no hospital should be developed as community medical centers for the education of the public in health measures and this also is all too infrequently the fact. We know that existing health agencies should be co-ordinated and brought into relations of effective co-operation for the community whereas there is at present overlapping and costly competition. The list of these shortcomings need not be further extended.

Whether if any or all such difficulties the cause is to be found in state controlled medicine in industrial and health insurance methods in cooperative clinics or in some other device aimed at bringing competent medical service within the reach of every citizen at a price he can afford remains to be seen.

I am by no means unaware of the narrow minded and exclusively self-seeking attitude of the good many practitioners who see in every social movement affecting medicine simply one more effort to rob them of a livelihood and loath to devote all their energies to doing in where they are. The position is like that of labor which has tradition ally opposed all labor saving machinery—and always in the long run is vain. The public interest is ultimately bound to be paramount. It is a very natural and venial fault to prefer one's own financial advantage to any idealistic social scheme however apparently beneficial to the public. Other professions notably those of business men and even possibly of teachers exhibit the same proclivities but in the face of this reactionary tendency if such things be we have to recognize that unquestionably there is a new social philosophy in the air and every phase of our life is bound to be affected by it sooner or later. This philosophy conceives the social order as a derivative obligation to give its members wholesome conditions of life participation from needless expense hither to limit of disease or moral depravity. It conceives human life as undeniably superior to money or physical property and firmly and indisputably for the radically modifying any age class practice which

OPHTHALMOLOGY, OTOLARYNGOLOGY

THE ACTIVITIES OF THE OTOLOGICAL RESEARCH LABORATORY OF THE JOHNS HOPKINS UNIVERSITY DURING THE PAST FIVE YEARS¹

SAMUEL JAMES CROWE, M D, BALTIMORE

THE Otolological Research Laboratory of the Johns Hopkins University was organized in 1924 for the purpose of studying the finer anatomy, the pathology, and the physiology of the ear. The pathology and anatomy may be demonstrated with temporal bones collected at random in the autopsy room, but a study of the physiology of the human ear is a more complicated procedure. For example, no temporal bone is of value in this investigation unless an accurate test of the function of the cochlea and vestibular apparatus was made before death. The specimen must be obtained within a few hours after death. The preparation of good histological sections is so essential, that approximately 1,000 temporal bones and several years of concentrated effort of the entire laboratory staff were required to develop a satisfactory technique for fixation, decalcification, and embedding. Our plan from the first was to examine with the greatest possible accuracy the hearing of every hospital patient whose general condition made it seem likely that he would come to autopsy. Many of these patients were found to have normal hearing. The histological sections of the temporal bones of such cases have been of great value, however, in developing a histological technique that is free from artefacts.

The most important and perhaps the most difficult task that has not been solved, is the interpretation of the audiometer curve and tuning fork tests. It is absolutely essential that the otologist should be able to determine from the tuning fork tests, the audiometer record, and the general diagnostic study (1) whether the lesion is located in the middle ear, the inner ear, or the auditory nerve, or, (2) whether there is a lesion in both the middle and inner ears. He must also be familiar with the common etiological factors of the various types of deafness. A clear understanding of the cause and pathology of hearing defects is absolutely essential. However, a clear understanding of the physiology of the various structures of the middle and inner ears must come first.

The brilliant work of Wever and Bray has given us a method of studying in experimental animals the part played by each separate structure in the middle ear in the transmission of sound. A detailed

description of the experiments has been published.² The most important conclusions are (1) the clearness and resonance of the voice is diminished by any change in the length and diameter of the external auditory canal, (2) pure lesions of the drum that interfere in no way with the ligaments or movements of the ossicles have very little effect on the transmission of words or tuning fork tones, (3) any experimental lesion that tends to interfere with the movements of the ossicles or *increases* the rigidity of the ossicular chain causes a marked impairment in the transmission of *low* tones, (4) division of the tensor tympani muscle, which *decreases* the rigidity of the ossicular chain, causes a marked impairment in the transmission of *high* tones, (5) puncture of the round window membrane, which allows a drop of the perilymphatic fluid to escape, results in a *profound loss* in the transmission of all sounds, (6) pressure on the round window membrane, which makes it tense and reduces its mobility, increases the sensitivity of the cochlear end-organs and the clearness and intensity of words and tuning fork tones are *increased* approximately 50 per cent.

These facts could never be demonstrated in a patient or in histological sections of the human ear because infection usually involves to a greater or less degree all of the middle ear structures. This type of experimental work, together with the functional, histological, and statistical studies on patients, will in time enable us intelligently to interpret the history, the general physical examination and laboratory tests, the local findings in the ear and upper air passages, the various tuning fork and audiometer tests make it possible to locate the lesion and understand its cause. When this has been accomplished we may hope to arrest the progress of deafness or possibly prevent its development.

SOME INTIMATE STUDIES OF NASAL FUNCTION

Arthur W Proetz, M D, St Louis, Missouri read an interesting paper on "Some Intimate Studies of Nasal Function, Their Bearing upon Diagnosis and Treatment."

¹ Hughson Walter and Crowe S J. Function of the round window an experimental study. J Am M Ass 1931 xcvi 20. -208

Crowe S J, Hughson W and Witting E G. Function of the tenor tympani muscle. Arch Otolaryngol (in press)

Crowe S J and Hughson Walter. A new method for the study of the physiology and pathology of ear. Monatsschr f Ohn (in press)

² Wever E G and Bray C W. The nature of acoustic response: the relation between sound frequency and frequency of impulse in the auditory nerve. J Exper Psychol 1930 xiii 5

³ Abstract of paper read at a special meeting of the Section of Otolaryngology, New York Academy of Medicine, October 13, 1931, as part of the program of the Clinical Congress of the American College of Surgeons.

concerned and not least for the reason that as in the two issues just mentioned and commented upon earlier in this paper the attractiveness of the profession to young men of outstanding qualities would be thus lamentably impaired. Further any measures which substantially limit the physician's responsibility for his medical judgment and actions by subordinating him in a rigid hierarchical system are sure to be vicious in their outcome.

Not some or all of these consequences may be inevitable in order to secure advantages which society will regard as outweighing them in importance. But I cannot believe that any such actions if taken will fail to work out most disastrously for all our people and I speak as a citizen and not as a doctor.

We have traditionally pitied the man who sold his birthright for a mess of pottage. It is by no means clear that we are not menaced by a similar danger in our efforts to secure a needed good which may entail the sacrifice of a still greater good. On the other hand if under altered form these values which I have recited can be preserved and much more if they can be developed and

enhanced I should have no fear whatever even the most extreme changes in the present conditions under which the medical profession operates. Nor should I have any fear that society would not only permit but insist that men who render such indispensable service should be accorded unequalled social prestige and a thoroughly adequate financial reward.

We may justly ask the medical man to accept wholeheartedly the new gospel of an enlightened social order exercising due care over all its members and with discriminating favors accorded to none. In essence this is the true spirit of American democracy. But we should not nourish our selfish interests where there are no higher motives to compel him to work under conditions which paralyze at the outset all the most powerful and worthy of his impulses to professional service of the highest character. As a layman then I wish to record my profound sense of gratitude to the profession which you adorn and to which humanity has from time immemorial been so indebted. While I as a user of the service desire of many of your fellow citizens to cherish and protect the sacred values confided to your care

FOREIGN BODIES IN THE EYEBALL¹

HENRY S. MILES, M.D., BRIDGEFORD, CONNECTICUT

THE conclusions here presented were reached from my experiences in treating patients who had or had had foreign bodies within the globe, together with a review of 78 history cards that were conveniently at hand.

The direct cause of the accidents in 56 instances was hammering, the remaining causes were 11 different kinds of work on metal and wood. There are no data to show how many of these workers were wearing their goggles, but most of those questioned did not have protectors on. Eighty-nine per cent of the foreign bodies in this series were of steel. The other substances were glass, wood, tin plate, copper, and brass. Several eyes totally destroyed at once by the explosion of a great many cartridge primers were not included.

The foreign bodies were located as follows: 14 were anterior to the lens, 18 were in the lens, 32 were in the vitreous, 5 in the retina, 3 in the sclera, and 6 passed completely through the eyeball into the orbit. Four of the pieces of steel passed through an eyelid before entering the sclera.

When the particles had evidently stopped in the lens, or anterior to it, a hand magnet was first used, and with this alone 8 pieces were removed. It was necessary to use the large magnet to remove 8 others from the lens. The bits of steel were so small in 2 instances that the giant Haab would not dislodge them, one lens was removed with the particle in it, the other piece remained within the lens which was only partially opaque.

It is conceded that with steel in the vitreous or the posterior coats of the eye the problem is more difficult. We must find out at once just where the offender is. Very often we need the help of a roentgenologist in our search for an opaque lens or blood in the vitreous is apt to be present to cloud the picture.

There are occasional slips by the X-ray operator. In not a few cases the foreign bodies are plotted too small. Negative reports have come to me in 5 instances where steel was subsequently removed. I am one of the ophthalmologists who uses the giant magnet, for overlooked pieces are small and will usually come into the anterior chamber.

It has been my custom to bring all the pieces measuring 3 millimeters or less in the longest diameter around the lens and through the pupil. I feel sure that I have never injured a lens by so doing. In drawing particles forward we are careful of our aim so the pull is not toward the ciliary body. All mine have escaped, at least, they did not tarry there.

I make a fair sized incision in the cornea, even though some aqueous may be lost. I complete the delivery from the anterior chamber with the large magnet in most instances to avoid the introduction

of another instrument, though it frequently might be done more handily with a small one.

In the series of steel cases, 25 pieces were extracted around the lens, 8 from within the lens, and 9 through the sclera, with the aid of the giant magnet, 8 were removed with the hand magnet. When steel was removed through an incision in the sclera a small nick was made at right angles, to favor gaping. It was necessary to go into the vitreous but once. A large piece with barbs on it was disengaged with a strabismus hook on the giant magnet tip. Most of the cases in which removal was through the sclera did badly. There were some detached retinas, and it may prove good practice in the future to cauterize about the wound in an endeavor to glue the retina and keep it in place. In one instance the retina was separated at the point of entrance.

The results were usually good when the foreign bodies were forward, and not so good when they were back of the lens. This latter was especially true of large pieces, or those extracted through the sclera. Many eyes were blind when first seen and several so badly injured that there was little hope. We promised nothing and secured all we could, not infrequently we were pleased if a good looking eyeball was retained. Five had to be enucleated but I have seen no case of my own with sympathetic trouble. Twenty-four eyes had no sight in the end, but remained quiet. Ten patients of the series were returned to referring oculists and final vision was not recorded. Nine had vision of some use and 23 had 20/40 to 20/15. One with double perforation had 20/30 and another 20/20. Seven others did not have their vision recorded. Several lens cases could have been improved by operations. Some people are seeking compensation who declare that they see very little, though we know that we have obtained excellent results.

In Connecticut, 20/200 or less is considered a total loss, industrially. Cataract patients have come under this head, though they may see, with their correction, 20/20. They cannot wear the strong lens if the other eye is anywhere near normal. It is my opinion that such cases should have a separate rating in compensation schedules.

Steel will work forward at times as well as copper and brass, twice pieces appeared in the anterior chamber of disorganized eyes. A disc or brass 3 millimeters in diameter entered an eye causing a cataract. It settled in the vitreous. There was just a slight irritation but sight was lost. At the end of about 3 months the disc presented itself through the iris below. It seemed an easy matter to open and take it out with forceps. I tried it. At the first attempt it retreated into the gel. In a week or so it was out in front of the iris again. I operated this

¹ Abstract of paper read at a special meeting of the Section of Ophthalmology, New York Academy of Medicine, October 14, 1931, as part of the program of the Clinical Congress of the American College of Surgeons.

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DEMONSTRATION OF MICROSCOPICAL PREPARATIONS OF EYES CONTAINING FOREIGN BODIES:

BERNARD SAMUELS M.D. M.A. M.P.H.

FEWER at ocular foreign bodies are entered today than formerly, owing to the fact that the little child is now used instead of the hammer and because precautions are taken requiring the use of goggles.

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Of all the macular degenerations, the most deleterious is the one which affects the central vision. It is characterized by a gradual loss of the ability to see fine detail and by the appearance of dark spots or "floaters" in the field of vision. The disease is caused by a degeneration of the macula, the part of the retina which is responsible for central vision. The disease is most common in people over 50 years of age and is more prevalent in those with a family history of the disease. There is no cure for this disease, but treatment is available to slow its progression and to prevent further vision loss. The treatment consists of laser surgery to destroy the abnormal blood vessels in the macula. This procedure is usually performed on an outpatient basis and is followed by a period of observation. The results of the treatment are usually good, with a significant improvement in vision and a reduction in the number of floaters. However, the disease may recur, and regular follow-up examinations are necessary to monitor the condition.

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because the capsule or body of the egg body has

been mistaken for a tumor. This is particularly the case with foreign bodies that have lodged in the stroma of the iris, where they may become surrounded by exuberant granulation tissue which in its rapid growth and shape may simulate a neoplasm or a tuberculous process. In a similar way, the capsule of a particle lodged on the inner surface of the ciliary body may cast a shadow on transillumination and lead to a suspicion of malignancy.

If a foreign body is seen suspended in the vitreous there is not much chance of its remaining there because its presence causes a liquefaction of the vitreous so that in time it will sink to the most dependent part. A favorite seat for foreign bodies found by accident in sectioning eyes, seems to be a bed on the retina below, just back of the ora serrata—the point

to which they have sunk after the liquefaction of the vitreous. Foreign bodies on the retina because of the contraction of their capsule cause the retina to detach, and with this detachment the foreign body changes its position. Such possibilities are to be borne in mind in repeated X-ray examinations made from time to time.

Sooner or later hyaline and other degenerative changes are apt to take place in the fibrous capsule of a foreign body, thus causing it to break down. When this happens the poisons generated by the foreign body itself and by the broken down tissue which is set free, may produce active inflammation and there may be set up sympathetic ophthalmia. An eye containing a foreign body is never to be considered out of danger.

WORKMEN'S COMPENSATION PROBLEMS OF INTEREST TO OPHTHALMOLOGIST¹

V. A. ZIMMER, M.D., ALBANY, NEW YORK

Division of Workmen's Compensation, Department of Labor, State of New York

FEW doctors realize their importance in workmen's compensation administration. In ordinary cases the physician has the single duty of diagnosing and treating ailments. In compensation cases, however, he owes the duty, to the claimant and to society, of determining whether and to what extent the disability and its cost are chargeable against industry.

In no branch of medicine is the responsibility more pronounced than in ophthalmology. No branch requires closer study of cases or keener professional analysis to bring about equitable disposition. Accurate measurement of vision is frequently difficult because of factors over which the doctor has no control—the non-co-operation of a patient, illiteracy, changing of pathological conditions, etc. Eye injuries are numerous and expensive. Early neglect or carelessness brings tragic results in loss of sight—infection due to the removal of foreign bodies with dirty handkerchiefs, the failure of the first aid nurse to recognize the seriousness of a condition, and even apparent lack of thoroughness on the part of the doctor.

In eye cases the Department will not close a case unless a medical report is filed, and it makes a special effort to have claims filed in every reported instance

because of the frequency of cases in which loss of vision has resulted after the lapse of the legal period during which a claim may be made.

The Department is constantly pointing out to doctors the necessity for making and retaining complete case records including visual tests and descriptive pathology of the injured eye. These data are of grave importance in cases in which the issue is one of activation or precipitation of a dormant disease and for comparative purposes in measuring the visual loss in the injured eye.

Under the theory of compensation principles, firmly fixed by court interpretation in this State, traumatic activation of a latent condition is the equivalent of causation. It must be determined in a very large number of cases whether and to what extent the injury incited the development of the diseases which in themselves are capable of reducing or destroying vision.

In order that physicians may have a better understanding of the scope and purpose of the law and detailed information as to its administration, the Department is assembling valuable data from studies of the large number of eye cases presented. This material will be available to any member of this society who may be interested from the standpoint of research.

¹Abstract of paper read at a special meeting of the Section of Ophthalmology, New York Academy of Medicine, October 14, 1915, as part of the program of the Clinical Congress of the American College of Surgeons.

porations—the training and education of workmen and foremen in safe practices are either completely ignored or subordinated to the very intensive education, training, and supervision given in methods of speeding up production, lowering costs, and maintaining standards of manufactured products.

A recent analysis of the circumstances surrounding 70,000 accidents has led Heinrich, of the Travelers Insurance Company, to the conclusion that 98 per cent of all industrial accidents are preventable, and of these 88 per cent could be prevented by proper supervision and administration.

One detail of industrial administration is of special interest, and that is the mandatory goggle rule which requires every workman in a hazardous department or plant to wear goggles at all times on penalty of discharge for violation of the rule. It is our understanding that such a rule has for a number of years been enforced in the Pullman Company, the American Car and Foundry Company, the Union Pacific Railroad System, and in some plants of the United States Steel Corporation, and that in all these companies the radical reductions in serious eye injuries are attributed largely to this rule. While this is common knowledge within the safety profession, the vast majority of industries have not yet become sufficiently interested to create and enforce the mandatory goggle rule.

There are two other important aspects of plant administration and supervision which justify Mr. Heinrich's assignment to this factor of a possible 88 per cent reduction in accidents. I refer, first, to the fixing of responsibility upon individuals for individual accidents, and second, to the securing of the genuine interest of plant executives and owners in thorough-going accident prevention. The Union

Pacific Railroad System, which for many years has taken first place in almost every nationwide safety contest and whose record is hardly approached by any other large railroad, attributes this enviable record primarily to these two items of administration and supervision. When every workman, foreman, and supervisor knows that every accident will be investigated and that the careless person, irrespective of his position in the plant, will be disciplined, and on repeated carelessness discharged, accidents cease to happen. Similarly, when the chief executive of an industry really becomes interested in preventing accidents and ceases to be content merely with the financial protection provided by insurance, the frequency of accidents is radically reduced because the many known ways and means of their prevention are conscientiously used by workmen, foremen, and managers who value their jobs.

What can the industrial physician or surgeon do in this situation? Frankly, there is little the medical man can do toward the direct prevention of accidents. There is very much that he can do in the protection of workers against the health hazards of industry. As is well known, there are many serious health hazards affecting the eyes of industrial workers that often lead to total blindness. This is especially true because of the steadily growing use of poisonous chemicals in industry.

There is a great deal, however, that the industrial physician or surgeon can do to help this situation indirectly, he can—often more effectively than the safety engineer, the insurance inspector, or anyone else—inspire the genuine and thoroughgoing interest of executives in the elimination of accident hazards as well as of disease hazards.

CLINICAL ASPECTS OF INDUSTRIAL INJURIES OF THE EYE AND ORBIT¹

GEORGE H. CROSS, M.D., CHESTER, PENNSYLVANIA

THE character of ocular injuries in a locality varies with the kind of industries in that particular region. However, foreign bodies in the cornea result from accidents in most classes of industry and comprise at least 60 per cent of all ocular cases. In an analysis of 4,541 ocular injuries occurring in industry, the author listed 2,670 cases of foreign body in the cornea.

The main points to be considered in this connection are (1) proper magnification for the operator so he can see what he is doing and can avoid denuding a large section of the corneal epithelium, and (2) removal of the oxidized tissue which is left after a hot foreign body has been removed. The round dental burrs, fitted into a suitable chuck handle, which can be easily and quickly rotated between the thumb and fingers, are used to remove the oxidized tissue and leave a smooth surface without any undercut edges to harbor bacteria or constantly irritate the eyelid in its passage over the area where the foreign body has been.

Next to foreign bodies the most frequent cause of injury is a burn, either from hot metal, a chemical, or electricity. Quite a number of industries use caustic soda in large quantities in the solid state and in all percentages of the liquid state. Caustic soda burns give no indication that they will always look much worse on the third day than at the time of injury, so that it is essential that remedial measures

be taken immediately to neutralize the caustic soda and change it to an inert compound. It has been our custom immediately to apply glycerite of tannin with a cotton applicator. This at once checks the burrowing action of the caustic soda.

Air hose injuries are of special interest, from a diagnostic point of view, in those cases in which emphysema of the conjunctiva is produced. When the hose slips off the nipple the worker does not know that he has been struck by the end of the hose and a possible fracture of the nasal and ethmoid bones has been produced.

When the center of the cornea is involved it is best to cover it with a Van Lint conjunctival flap. In penetrating wounds of the cornea, no repair surgery is attempted until we have had a report from the X-ray laboratory with respect to the presence of a foreign body in the globe.

A case in which a non-magnetic foreign body was removed from within the eyeball is of interest. A lad about 7 years old, with a large piece of copper in the vitreous, was treated by a slight modification of the author's method for the removal of non-magnetic lead shot from the vitreous. In this case the tips of a pair of curved mosquito forceps were inserted into the large wound of entrance made by the copper fragment and, following the directions of the fluoroscopic operator, it was possible to grasp the copper and successfully remove it from the vitreous.

¹Abstract of paper read at a special meeting of the Section of Ophthalmology, New York Academy of Medicine, October 14, 1931, as part of the program of the Clinical Congress of the American College of Surgeons.

CONFERENCE ON TEACHING OF SURGERY

GRADUATE AND UNDER GRADUATE TEACHING OF SURGERY

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GRADUATE TEACHING

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The American College of Surgeons fills a real need in this respect. However, attendance at its meetings is not sufficient even for those qualified in the specialties it serves. Supplementary means must be used.

GRADUATE TEACHING OF SURGERY

GEORGE J. HEUER, M.D., Cincinnati, Ohio. The subject is discussed from the viewpoint of the better class of graduate students who are seeking careers in surgery.

An attempt has been made to discover not only opinions as to the work now offered for graduate instruction in surgery but views regarding the sort of graduate instruction wanted. It appears that the chief criticism of the opportunities now available is that they do not permit a comprehensive surgical education but are more in the nature of preparatory courses which, at their completion, leave the graduate student in the position of again having to seek further means of study. It appears that the sort of surgical education being sought is one that will include the opportunity of doing a fairly large amount of operative surgery. It is a question whether it would be possible or desirable to give graduate students the kind of surgical education they want. To do so would require certain adjustments not only in the attitude of many surgical teachers toward graduate teaching but in the arrangement of surgical services in teaching and other hospitals.

GRADUATE TRAINING OF SURGEONS IN THE MAYO FOUNDATION

LOUIS B. WILSON, M.D., director, Rochester, Minnesota. The Mayo Foundation, a part of the Graduate School of the University of Minnesota has the use of the laboratory, library, museum facilities and the clinical material of the Mayo Clinic. These facilities are adequate in all departments except anatomy, in which graduate work may be done in the Medical School in Minneapolis.

About half of the members of the faculty in laboratory fields are engaged entirely in research, and the remainder partly in research and partly in routine work. In diagnosis, opportunity to study adequate material of great variety is provided in fourteen general diagnostic sections and in twelve special diagnostic sections. More than 1,100 beds are available for surgical patients.

Graduate students are paid small annual stipends as fellows of the University of Minnesota. Twenty to twenty-five are appointed each year on a competitive basis. Young applicants who stood high in the best schools and have had the longest hospital or laboratory training in the best hospitals or laboratories are selected. They come mostly from schools in the United States and Canada, though a few are from foreign countries. They average 27 years of age

at the beginning of their residence, and have had an average of about 2 years' graduate training in hospitals. Each fellow elects the work he wishes to do and the person with whom he wishes to do it. The fellows average about 9 months of laboratory work, 15 months of service in diagnostic departments, 1 year of operative second-assisting, and 1 year of operative first-assisting. Their residence is more than 4 years. In order to qualify for the degree of Master of Science in Surgery they must be competent to begin the practice of surgery in a scientific manner without supervision, present an acceptable thesis based on original research work, and pass searching, written and oral examinations. The respect in which graduates of the institution are held in the communities in which they are now practicing warrants the continuation of the present plan.

GRADUATE TEACHING IN SURGERY

GEORGE P. MULLER, M.D., Philadelphia. Criticism of surgical judgment and sometimes of operative technique seems justified after surveying the educational process by which a surgeon is made. Leaving entirely out of consideration those irregular doctors who practice surgery through the aid of fee splitting physicians, it is apparent that surgeons are developed by the simple process of obtaining a hospital connection together with aid of graduate instruction, by being attached for a period of years to a recognized surgeon, or by remaining for a number of years as a full time assistant in surgery in one of the University Medical School Hospitals.

If a proper balance is maintained between research and the clinic, the ideal training for high grade surgery will be found in the university clinics. These men will be the leaders in the future. The great bulk of first class surgery will be done by those men who have been well trained by a surgeon interested in their welfare. In most cases overemphasis is laid upon technique, and the assistant surgeon is not allowed sufficient time to become proficient in the basic sciences. Most of the difficulty lies in the fact that these men sooner or later must make a living and this often interferes with their educational development.

The greatest problem before us is how to educate hospital managers so that more careful appointments to the surgical staff will be made and that men who simply aspire to doing surgery will be kept out until adequate evidence has been offered that they have become proficient in the art of surgery and have been sufficiently trained by an experienced surgeon to have developed judgment. If the schools for graduate instruction, as existing today, would be more discriminating in their selection of students it is possible that such instruction could be obtained through them by teaching which would be spread over a period of years and not confined, as at present, to a few months or even a year.

In the cancer clinic the fields of responsibility of the social service worker embrace the facilitation of early diagnosis and treatment, following up patients after treatment, and collecting and interpreting social data of significance.

When the diagnosis of cancer is made, the social service worker helps to remove all obstacles in the way of the patient's carrying out the recommendations for treatment, and this is the most important work. The psychological aspect of the patient's problem is the serious and immediate concern of the social service worker. She discusses plans and resources with each new patient and helps him to work out a solution for himself, which must include consideration of his family and his economic situation, and religious and racial prejudices and superstitions. It should be the social service worker's responsibility to see that the patient is definitely referred to the proper clinic or hospital or back to his own doctor, and to interpret his medical problem to his family and to those who may be directly interested in his social welfare, so that last but not least, the social worker is contributing her share to the educational program in the control of cancer.

CHARACTER OF CONFERENCES OF THE CANCER CLINIC STAFF

EDWARD J. KLOPP, M.D., Philadelphia. The organization of a cancer clinic in a general hospital in a large city should consist of a surgeon, a pathologist, a roentgenologist, a radium therapist, an electrotherapist, an internist, a gynecologist, a dermatologist, a urologist, a bronchoscopist, an otolaryngologist, a chemist, a chief of clinic, a stenographer, a technician, and, if possible, a social service worker.

Meetings should be held weekly at which new cases should be studied and old cases reviewed. The method of study and investigation and plan of treatment is decided upon by a group. A report of all cases presented should be sent to every one directly interested in the clinic. Records should be kept in accordance with the approved blanks of the American College of Surgeons. The chief of clinic should be responsible for the records.

Advantages of cancer clinics to patients. The patient receives careful consideration, good advice, and the best treatment the hospital or the community affords. The popularity of the clinic has a tendency to divert patients from cultists and charlatans.

Advantages to physicians interested in the clinic. The individual physician will see a larger variety of tumors, and the opinions of others will give him valuable information. Every physician, regardless of his special work, will see the results obtained by other men. Many surgeons know little about the response of certain tumors to irradiation. The radiologist has an opportunity to see tumors before operation. The pathologist has the privilege of seeing the tumor in mother soil. His suggestions are of the utmost value. A group of physicians see a number of patients in a systematic manner with all

records at hand during the clinic hour, thus saving time.

IMPORTANCE OF NOMENCLATURE IN CANCER CLINICS

WILLIAM CARPENTER MACCARTY, M.D., Rochester, Minnesota. The discussion of the "Importance of Nomenclature in Cancer Clinics" appears in full on pages 317-328 of this issue.

RADIUM CONTAINERS AND THE CUSTODY OF RADIUM

EDWIN C. ERNST, M.D., St. Louis. The use of radium in a general hospital may be subjected to many abuses, unless such an application is under the control of an experienced physician or the administration of radium is limited to a small group of surgeons who have received the proper technical training and have had the necessary practical experience in radiation therapy. The promiscuous use of radium by inexperienced members of any hospital staff is to be deplored if the best interests of the patient are of primary consideration. The question of proper radium containers is a highly technical physical problem. The importance of the protection of the patient, the doctor, and his co-workers from the rays of radium are equally emphasized throughout this discussion. The recommendations of the International Congress of Radiology with reference to the minimum radium protection standards are discussed with respect to the possible undesirable effects upon the radium workers in charge of this type of therapy.

THE UNIFORMITY OF CANCER CLINIC RECORDS

LOUIS I. DUBLIN, Ph.D., New York. Medicine and surgery have long needed effective, economical records and follow-up systems whereby methods of treatment and end-results could be determined and evaluated. And this need is especially apparent in the field of cancer diagnosis and treatment, where determination of the end-results of treatment is conditioned by precision and completeness of clinical observation and by time and patience in the follow-up. A record and follow-up system for cancer cases must be uniform for the several agencies in the field in order to secure an adequate base for cancer observation and so that experience may be combined with the least expense and the greatest general utility. Uniformity in respect to the following features of the record is essential to the further and more productive study of case experience. (I) The general record of the patient in respect to social and economic status, personal and family history and of those many factors of bodily economy which may, some day, be deemed significant in the chain of circumstances leading to malignant new-growths. (II) A special record according to each major site for the carcinomata, with further and special details regarding the patient's occupational or domestic life or history which seem to have a bearing on the carcinoma of the site under treatment. (III) A special

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 ng path l g c l m a t e l m a y a l s b e s h o d

do t r n d b p u a d d that the prop r p
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 C l l e g e s p e c t e d to r f e r the p t e t t e t e r
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II CANCER SYMPOSIUM

A b s t t f th pap r d d s c o s p e
 sent d t th C n Symp m held d g
 the Ch i a l C n f i th Am c a C l l g
 of Su go s N Y r k O t o b 5 93 p e
 se sed n the f l l o g p g s D R b t B
 G e g h B t n p d

REPORT OF THE COMMITTEE ON THE TREATMENT OF MALIGNANT DISEASES

RONE T B GREY O U T MD Ch ma
 B t f r e s n t e d p t f the C m m t t the
 T e m e n t f M i g n a t D e s e s w h c h p b l s h d
 l s e w h e r e ; t h s i s s u (e p 430)

THE ROLE OF EDUCATION IN THE CANCER CAMPAIGN

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 m d e th e m d al p o f n d w th t h a t y
 by the e k n l h d e p s t a t of the America
 S c t y f r the C t o l f C n h b h t o u t
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The typ of d a t i n e d d a d f e d
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 th p f d f f t t y p e s b u t s o c o l g f
 e c o m n d p l t l s u b j t a s n

2 The educational needs are diversified according to whether they involve the profession, the laity, or both. Since the profession tends to specialize, it is desirable that the general phases of the educational program in the field of cancer be handled by those who are not themselves specialists in any one particular phase of medicine.

3 The types of education needed vary under local conditions and thus cannot be met by a general or comprehensive long distance treatment.

4 The types of education needed must be correlated in order to prevent over-balancing or under-emphasis as the case may be.

5 The situation often demands education against certain existing menaces as well as the construction of new types of behavior by the laity.

6 The educational problem is often non-technical and therefore requires the study and advice of a group of field representatives which is composed not of highly technical experts but of men whose training is especially designed to give them sympathetic rather than professional contacts with lay groups.

7 The educational processes often are of the nature of public health problems thus requiring the type of field representative who can deal with health officers and the various unavoidable political aspects of the situation.

It will thus be seen that cancer is a problem requiring a well balanced and continuous organization to handle its various phases. Education must be planned to meet the training of the people affected and the local conditions, and to urge the non-partisan presentation of conservative information.

PLAN OF RADIOLOGICAL WORK AT CALIFORNIA INSTITUTE OF TECHNOLOGY

SEELEY G. MUDD, M.D., and CHARLES C. LAURITSEN, Ph.D., Pasadena. For some time radiologists have recognized the desirability of investigating the clinical effects of extremely hard X-rays in the treatment of deep seated malignant tumors. Inasmuch as apparatus for generating X-rays of this type had been in use at the California Institute for Physical Research, it was deemed desirable to use this equipment for clinical purposes. A brief description of the equipment now in use is included. Reference is made to the installation at the new W. K. Kellogg Radiation Laboratory which is expected to be finished at the end of the year. The operating conditions have been maintained constant for all of the therapeutic work and are as follows: tube potential 550,000 volts peak, tube current 4 milliamperes, filter 6 millimeters steel 1 millimeter aluminum, and 8 millimeters felt, target skin distance 50 centimeters. Under these conditions the output, measured with the free air chamber, is 20 roentgens per minute.

The medical work is directed by a Medical Advisory Board, appointed by the Institute. During the past 9 months 85 persons showing evidence of inoperable malignant growths, without general metastasis, have been treated. The erythema dose

is 900 roentgens. No alarming systemic reactions have been observed. Obviously sufficient time has not elapsed to permit discussion of results. It is contemplated to restrict the groups of patients treated and study more intensively malignant tumors of the rectum, larynx, esophagus, and breast. During the past few months studies have been carried out on rats, comparing the effects of X-rays at potentials of 200,000 and 550,000 volts.

NEWER DEVELOPMENTS IN X-RAY THERAPY OF CANCER

RALPH H. FRENDEN, M.D., New York, presented a discussion of the "Newer Developments in X-ray Therapy of Cancer" (see p. 329).

THE VALUE OF RADIATION IN THE TREATMENT OF BREAST CARCINOMA

SIR GEORGE LENTHAL CHEATLE, K.C.B., C.V.O., F.R.C.S., London. On account of its relative radio-resistance, I have been treating mammary carcinoma by means of interstitial radiation. By this means I have exposed six breasts and the axillæ of the corresponding sides to 18,000 milligram hours extended over 8 days. I have examined microscopically whole sections of the entire parts removed, 5 of them 6 months and 1 of them 18 months after this treatment, with the following results.

In the first 5 cases, all showed what appeared to be complete regression clinically, and I discovered that most of the disease had been put out of action. However, they all contained some carcinoma cells which looked to be active, viable, and potential sources of future extension of the disease. Therefore, three factors should be borne in mind:

1 These particular cells may have been untouched by the treatment.

2 If they were untouched, the bed in which they existed may have been rendered incapable of supporting or allowing their further activity and that therefore they may eventually die.

3 The question as to whether these viable looking cells are biologically as active as they look.

In the sixth case I could not discover any active looking carcinoma cells at all. Such a result suggests that if eighteen months had elapsed in the 5 cases mentioned instead of only 6 months, they might also have shown the same efficient result as the sixth case. I do not know. And because I do not know, my present opinion is that it is safer to remove by surgical operation all breast carcinomata that are presumably clinically operable.

After this operation I externally radiate the whole area of the side of the thorax from which the diseased area has been removed. I adopt this partly empirical plan in the hope that if there be any carcinoma cells left which are amenable to external radiation they will be destroyed.

As a rule I do not submit a presumably clinically operable tumor to a preliminary external radiation. I admit that by so doing it might be proved whether or not the tumor in question is exceptionally radio-

and thus the question might arise as to whether a surgical procedure would be indicated. But the fact remains that most of the tumors are relatively radioresistant, therefore a general rule is invariable time would be wasted by postponing a radical removal of the disease.

THE PRESENT STATUS OF MALIGNANT DISEASES OF THE STOMACH

Donald C. Balour, M.D., Rochester, Minnesota. The fact that cancer of the stomach can be cured by removal of the local growth and regional lymph nodes is not being emphasized enough. Many cases have been reported of patients who have lived the normal expectation of life following removal of such lesions. Although statistics show a gradual increase in the rate of mortality, yet the great problem remains the same, namely, early recognition of the disease and prompt operation.

Pessimism with regard to the cure of the stomach cancer is diminishing the last and the medical profession. Attend away from this attitude; apparent defeat is the same as defeat in the campaign against the stomach cancer. The statistics regarding the survival of patients should not be considered.

the last as often physicians so pessimistic in their attitude toward cancer that the patient has little encouragement for the only program which offers him help.

One of the problems of cancer of the stomach is its relatively chronic ulcer. Failure to distinguish early cancer has been the dominant symptom.

Another obstacle in the treatment of cancer of the stomach is the lack of operation. The belief however exists that a patient has no hope of survival without the removal of the stomach. The stomach can be dealt with a mortality rate of 50 percent or less. Preoperative preparation is the type of operation after cancer should be emphasized.

There is no need that the time to live with the stomach will become more and more efficient. Every cure is not bettered as 5 percent of cases in which the lymph nodes are involved and the record for May, 1935, shows 75 percent survival. Great satisfaction is felt in the stomach. From the standpoint of palliative surgery, cancer of the stomach is not much different from cancer of the stomach. These facts should be constantly stated both to the patient and to the physician.

CONFERENCE ON TRAUMATIC SURGERY

INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

An abstract of the papers presented before the Conference on Industrial Medicine and Traumatic Surgery follows. Dr Frederic A Besley, chairman, presided.

A SURVEY OF THE FIELD OF INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FREDERIC A BESLEY, M D, Waukegan, Illinois
The desirability of rendering more scientific, adequate, and effective treatment to the sick and injured in industry and, thereby, limiting the enormous human wastage, admits of no argument from a humanitarian viewpoint. Fortunately, it is no less desirable from an economic and financial consideration and gradually, but surely, the leaders in industry are coming to understand this phase of the situation. The work of this Board on Industrial Medicine and Traumatic Surgery has been in progress for 5 years and, like all new educational movements, it has had many vicissitudes.

During the past year the work has received a new impetus through the keen vision and guiding influence of our Director-General, Doctor Franklin H. Martin. He has assumed a most active interest and has placed in the field two excellent, highly trained men, Dr Williamson and Dr Newquist, who have made a careful study and a detailed survey of some of the larger industrial clinics and the methods of these industries in the care of their ill and injured.

As a basis of this study, the minimum standard for industrial clinics, as established by this Board, has been used. (See p 441 for terms of minimum standard.) Up to the present time, 174 clinics have been visited and of them 84 have been approved as fulfilling the requirements of this minimum standard. The number of facts, figures and the amount of educational material these men in the field have accumulated is enormous, and their reactions, deductions, and reports are most enlightening. Their work will go far in aiding the authorities of the American College of Surgeons in developing this new department of activity with background and intelligence. One outstanding observation that has been made is the lack of appreciation on the part of industrial executives of the enormous possibilities for economic gain if their employees are kept fit or if injured or sick, are restored to an earning capacity in the shortest possible time known to scientists and experienced physicians and surgeons.

Statistics are being accumulated that will show beyond any reasonable doubt that, if intelligent

medical organization with authority can be inducted into the health welfare of the workers in industry, there will be a financial saving of millions of dollars yearly. Mr Walter E Carr has done a constructive piece of work in the analysis of this phase of the situation.

You are all familiar with what happened to the soldiers in the army previous to the late World War. Typhoid, dysentery, tetanus, and gangrene were rampant and caused far more deaths than did bullets. It can be stated in all fairness that until the late war the higher staff officers and executives were prone to regard their medical departments as necessary evils that were tolerated but rarely consulted regarding the health and welfare of the troops. The staff was self-sufficient.

All of this was changed in the late war and the transformation occurred as a result of an understanding on the part of the statesmen and higher staff officers that it was necessary to consider all the circumstances surrounding the health and welfare of the men in the ranks if they hoped to secure and maintain an army with a high morale, great loyalty, efficiency, and effectiveness in the field. As a result of this understanding, it was immediately recognized that this accomplishment would be possible only if a staff of medical men with scientific training and practical experience were given sufficient authority to execute a well-made plan. The authority was granted. It is not necessary to elucidate the beneficial effects of the splendid medical organization whose counsel and advice were accepted and acted upon.

Is there an analogous situation existing in industry at the present time? It is believed that there is. Think what would have happened and the chaos that would exist now if no pre-enlistment examinations had been made. How many complications and embarrassments will a carefully made and recorded pre-employment health audit save the employer? This audit protects, also, the best interests of the worker. Some of these questions the American College of Surgeons will be in a position to answer intelligently and correctly because of its intensive study of the circumstances and conditions connected with this large subject. The lack of comprehension and appreciation of the importance of this subject of health and welfare of employees on the part of industrial executives is natural. It is due, at least in part, to the failure of the medical profession to indulge in a larger program of education. Wise men know that, in this rapidly changing and incalculable

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SURGERY CLINIC IN SMALL INDUSTRIES

HART E FISHER M D Ch c go p epa ed paper
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VALUE OF ETHYLENE IN TRAUMATIC SURGERY

DONALD GUHRIE M D S y c P an y l a a
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n s h e a c o c l a t o o f t h e e d e s l t s f l l w i g t h
d f l e n t m e t h d o f t r t m e t o f t h i j e d a d
a l u a t s t h e t h p e u t m e a s u r e m p l y e d i n
a n t e c o n d t o n t d l s t h e c u s e s o f f i e s

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f l l o u p c f e P r e n t e m e d i n e n a t i r a l l y
c o l d n t n a l l i t p h s s b s c c f l l y p p l e d
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t n a s g d r t h u g h t h e f l l o u p l a u

A c o m p l e t h i s t r y n e d p h y c a l a d u
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Th c l l g a n t o f t h f l l o p h o l d
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t y f o e s g c a l f y g a d e a t t g
t h e k n l e d n w l b l

UNILATERAL FRACTURES OF THE CONDYLES OF THE FEMUR AND UNILATERAL FRACTURES OF THE TUBEROSITIES OF THE TIBIA

WILLIAM R. CLUB S M D F A C S A R T a f
H C O L E Y M D J M E S J C A L L A N A M D a f
C R O S S C U D E R I M D C h c go l l l A t o
m b l a d a t o n d t c a a g a m a k e d
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f c t m y c s t o f s p l t t g f l o f t h l
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c d a d b e t t h f r g m t T h t
m t c o m m j y t h t i h c h t l t
t b e s t c h d d w d t h i t s e u t y
n t h t e p s t e r r p t f t t t
b r g s f h m t h t h l t t
m m c d t a b d f m t l t r a l a t t h m t s
a d a l l d t h n g f e e t h e j t r f c t e l
a d t t t h e m f t h e j y

W b t t m p t d t p r t h e s j t h
p n p e t n s h c h t h e m e n s m d
t h e b o f g m n t s e s t r u c t d t h t m t e
w r w t h f g m n t f b e b t d f m t e
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c d t s c o t e d a t t h t m f p e t n

The differences between injuries to the medial tuberosity and the lateral tuberosity are emphasized. The lateral tuberosity is fractured in 9 out of 10 cases. The medial tuberosity is dislocated backward and downward, instead of being crushed as is so common with the lateral.

In unilateral fractures of the condyles, it is difficult to hold the fragments in position with traction or casts, owing to the fact that the gastrocnemius causes a rotation backward and downward. These have been corrected with metal screws, as they are more easily applied and because the large thread holds more firmly than bone or ivory screws. With loose closure of the joint, extravasation of the fluid contents aids in keeping the joint cavity clean.

SOME METHODS OF REDUCING INDUSTRIAL ACCIDENT SEVERITY

J. J. WITTMER, M.D., New York. The medical factors in the reduction of severity of industrial accidents are as follows:

1. The examination of all new employees. Our experience has demonstrated that all persons considered for employment, regardless of the work they expect to do, should have thorough physical examinations. A definite physical standard should be set up for each type of job. In this way employees will not be a hazard in any particular kind of work and, at the same time, will be stronger and healthier after many years of labor.

2. The re-examination of all employees at definite intervals. Physical check-up of all employees often reveals incipient degenerative conditions, aggravation of minor physical defects, inability to stand the strain of certain kinds of work, or mental inertia due to prolonged routine, monotonous, daily regimen.

3. The provision of adequate first aid treatment immediately after an accident has occurred, so that the injury received shall not be increased in severity.

4. First aid education. It is my firm conviction that adequate first aid cannot be rendered in accident cases unless all employees are instructed how to use the material furnished, why it should be used in the manner specified, and unless an adequate and constantly maintained supply of the material provided is accessible to each employee, whatever his duties may be, or wherever they may carry him.

5. Adequate and painstaking medical treatment and control of the case throughout the period of complete and partial disability of the patient. It is essential, if a doctor is to be successful in traumatic work, that he look at each injury as an analyst, as a scientist, as a lawyer, and as a business man.

6. Complete rehabilitation of the patient so far as is possible, by proper reconstructive treatment to minimize the loss or deformity to as great a degree as medical science at present permits. The doctor must keep in mind that the severity of the accident depends upon the outcome of the injury. Usually the result is very greatly affected by the nature of the treatment and a great responsibility therefore lies upon the doctor. Severity is gauged by the time

lost from work and the extent of the deformity. A vast amount of lost time can be saved and inestimable good done by intelligent and persevering care from the moment the injury occurs until it is finally cleared up. We have reason to believe that such procedures are justified because of the following results:

1. The reduction of severity, i.e., fatalities lessened, lost time reduced for all types of injuries.

2. A very low incidence of infection.

3. The very considerable reduction of compensation awards for deformities and permanent partial disabilities.

4. The improved morale of the working forces due to their knowledge of the genuine interest and efficient care taken of them by their company.

5. The increased working ability of the men in the field through their being kept as nearly as possible in first class physical condition.

SPONDYLOLISTHESIS

HENRY W. MEYERDING, M.D., Rochester, Minnesota, discussed the subject of "Spondylolisthesis" (see p. 371).

LOCAL ANÆSTHESIA AS A FACTOR IN REDUCING THE MORBIDITY OF TRAUMATIC SURGERY

LT.-COL. MORTON WILLIAMS, Great Lakes, Illinois, discussed the use of "Local Anesthesia as a Factor in Reducing the Morbidity of Traumatic Surgery" (see p. 378).

THE ADVISABILITY OF THE EARLY RETURN TO WORK OF THE INJURED

WILLIAM L. ESTES, JR., M.D., and L. A. SHOUPE, M.D., Bethlehem, Pennsylvania. Wisely has it been said that the *tyro* in medicine treats the disease and not the patient, but that to *cure* patients we must treat the *patient* together with the disease. So with the injured, too often interest in the injury or the type of fracture, in methods of reduction, maintenance of reduction, and return of function, etc., is the absorbing problem, and the injured man himself—his reaction to his injury—is neglected. In severe injuries with prolonged disability, the injured man easily becomes discouraged with respect to the early use of the disabled part, he develops an inferiority complex, as it were, toward any work or job, an attitude that is quite abnormal. He may be worried by physical therapy and not understand it, or have difficulty in co-operating in the use of, unusual or unfamiliar methods to regain function, since his attention is focused constantly on the disability which persists and which must be overcome.

If, however, after *some* function has been restored in the injured part, he can be put on a job, or back on his old job, preferably in the same environment or in the same shop where he worked before, his mind is again concentrated on work to be done, he realizes he is still good for something, and in the distraction—incidental to this work or job—of his thought from his injury, he subconsciously or unwittingly uses the disabled member by normal or natu-

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the py the comp ntu n to wo k and ca nng po e
tende t or foreman of th shop here the i j d
man a mpl yed Th sup untendent t t man
or both m st be old on the side Oite the a d
f fell kmen mu t b e l ted t e co ge the
i ju ed man t help hm pck p the th ead f h s
ne old j hand to re a ne nidence n h bily
t a ry on

Each divid al ca e m st be d c d d n ts own
me ts The early retu n to wo k and ca nng po e
of the iur d s an asset t () the i n j r d man him
If () th nd stry (3) th empl ve -labo ela
tu ns.

THE PREVENTION OF SHOCK AND TRAUMA DURING THE TRANSPORTATION OF TRAUMATIC SURGICAL CASES BY FIXED TRACTION SPLINTING

WILIAM L. KELLER M.D. Washi gton D st t
f C l mba W th the moto z o of great pr p
ton f u et cles of f a sportati n the p po to
of r m te su g ry h s i c e s d e p e llv ma
f a t s of th xt em ts and ne b ck a d
t ma f t n su hump t f a to s n th m r
talty f t a m t ur ry e f t h ld b
m d t el m ate th s f ctors

Many of ur p e t r n p o t i o n splnts a
umb r m t s ch d gee that t s d f ult
t n p o t the splnted pas ent e cept by mbul e
nd s n e ambulanc e ntal ay al ble d
utomobile s u u lly c ble t s m p t t
that th spl t h ld or add t u d f lte
Th y r ften o d f ficult t pply th t trauma
de t t p l t a t o n s t e n g e r t h a f the pl t
s g om tted Spl t fo t r n p o t a o h ld
b l ght d n mb om d f ch d gn
a top sm t p l c a t > Th t d d Th m
pl t wh h dm ble fo t e a t m t h o s p t l
is a t a l a y s b e t f o t n p t i n th r n g a
f t e n t s m l l r t o l g a d c a th pl c e l
n a n m e g e c y f a f o m th of p p l y Th v
do not e t g a t e the tub ty f the h m nd
c seq t l o thle s f t t s
o r n e d

No all maj f a t e f th l w r e t m t h
army h i g e d h l f r n g s dm abl It s e s i y p
pl ed by sl p p n g t i t p u o n from the de th
up p a n r t u m a f all maj fra t of th
upp t e m t j the M r r a y h n g d Th m a y m
spl nt sl ghtly mod fied t p r m t t s appl cati n
from the s d e s i d l s t h n g p r m t the m
t b e p l c e d n s p s t n and t l l m a n t a
t n

All i n j u r i e s of the extremi t i e s require g t r a p o a
t o n sh uld be t e a t e d potential f a t u r e s
s p l n t e d a t o n c e th m i n i m u m h a n d l i n g O p e
w o u d s s h o u l d b e t e m p o a l y t e d t h a n m
g e n c y p r o t e c t i v d r s w h o t h a d c o n t a c t O n
c o m p l e t o n of t r a n s p o t t n p l i t s c a b e r e p l n
o r m o v d p e r m a n t l y d e p n d g o n the f i n d n s
a t s m i n a t o n

INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FRANKLIN H. MARTIN M.D. D e t r o i t
A g g r g a n a t n m y b p o d t t t t h
c o d a t e d g o p o f l o l l r s a n d p m t e r s h
r p r t p a t i g n t h s m e e t g n s d i s t r a l
m e d c e a n d u m a t i g r v

Why? B e c a u s e a g n s t t h a t c a l e d t
k p e m p l y e s a n d f i s w e l l a d t s i f
the c e m p l y s d o f f i c i a l w h e t h e y w e i l m u s t
h a t h e e t h u a s t c s p p r t f t h m e n b
p a t c m e d n d s u r g e r y I t m s t h
c o p e r a t s p p o t o f t h e m p l y e s n e l d a n g t h
m d o m e n h o w o r k w i t h h d l t
m s t h v e t h e n t h u s a t c s p p o r t f t h d m t
n d n s r n e m p a s a n d f i l l y t m u t h
t h n t h s t u p p t f t h e h m a k e d
d m n t e u r l a

A n d n t h s y m p o s m t o d a y w e h n
p l a t f m t h e l e a d s o f a h o t h e g o p m d u l
m e s a m l a w i t h t h q u r m e t a f d i y
e m p l y e r p s n t g u i m p o t t d u t e s
e m p l y e s p r e e t d b y i f l u e n t s i l b o l e r s
f l f i t h l d g d e m n t m p e s r
n e x G o f t h a s e t c o m m l t h
l o k h w t h h i s m l u s d m n t t f t
h t h l r v t h S t a t e p r e p a r e d e l t h
m t a l l u m t g d u m n t s t h p l m s f
d u s t i l m e d i c n e t h a t h b e e n w t n
D u g l t h s t h h l t h n d l v i g
d i o o f t h e g e t b o d y f e m p l o y e s h a l t b e e n
i l l y p t e c t e d b e f d i f f e r e n e b e t e n t h
p e s t a t e t t h e c r o u g p s T h e h
n g t t e t g t h e r a n d a o p e t g i
t h e b y s g h l t h a d h p p s a d b g
n g b u t u l d n m c

I h a v b n f i t t e d b y t h p r t h h h e
b s t t t h A m e r i c a n C l l g e o f S g s T h e
C o l l g w t h t s o o o o F e l l w b f u r h d
d t r e s t e d i d e s h p t h a p c t e l b y t h
h m l m e n t s n t h u s p r b l m

F l u e e d b y t h c m p l m n t a d l g t h t
t h C l l g h s h d m r e t h a n a t i l l e d m u
b t g n g a b u t t h b e t t r c o p e t n l c a n t
f o r g e t t h b e t t r b s n s h s c m e t c l i z t h
c o m v l u e f t h h n e s t c a e o f t h p l t h
p e o p l a r e e o g u g t h e l e o f t h s e f f r t h
p l e f m d c e h a w a k d t t h l
f t h e e f f t n d h c d d t h s e r v e f m
t h t g m f t h e p c o t t d s r n p a c t
d f r l y t h s t t s h a e t k e n a s t n g h a d
g u l a t i g t h p r b l e m f g r t b u

A n t n a l p o t d i c a t e d t h t t h c a s u a l
t e s n t h c n t r y a m o g w o l n d u s t r y

numbered 19,000 killed, and 2,500,000 lost time injuries without death. Approximately 32,500 were killed, and over 1,000,000 were injured in automobile accidents.

Hence it is no longer a hit or miss problem, but one of the substantial programs that marks the march of civilization, in which the American College of Surgeons is proud to be known as one of the factors, and in which it furnishes a progressive, disinterested yearly audit based on a true standard and backed by actual surveys. As the Director-General of the American College of Surgeons and as its official representative, I wish to express the appreciation of my associates for the generous response of our guests to our invitation, and for their efforts in behalf of this program, in which our organization is so vitally interested.

THE INDUSTRIAL ACCIDENT CASE

WILLIAM R. McCURE, M.D., Detroit. In the problem of the industrial accident case, the question of prevention is already being well studied and handled by safety departments in most of our industries. It is simply a business proposition.

In regard to treatment, the lessons learned in the World War in controlling infection are far too important to be forgotten. The first of these was the great importance of complete surgical care at the earliest possible moment. Application of this lesson to our problem is best made by increasing the numbers of industrial hospitals. These need not be elaborate. Our mobile surgical units in the World War carried out major surgery with equipment easily loaded on a few trucks. Industrial hospitals so equipped would allow quicker surgical attention than can be obtained by sending the injured to some outside hospital.

The second lesson of the World War was the necessity of a special technique of surgical procedure in caring for traumatized and infected tissue. This brings up the need for specially trained industrial surgeons. Medical schools alone cannot go far in training these men. The hearty co-operation of the industrialist is necessary. When the industrialist recognizes the value of the trained industrial surgeon and will pay accordingly for his services, then medical graduates will be willing to take supplementary training in the larger industrial hospitals. The work of such specially trained men working in special industrial hospitals will do much to improve the lot of the industrial accident case. If these men later go into private work they will be a great asset on the staff of community hospitals in the care of patients suffering from accidents received in the street or home, or in industrial plants too small to maintain a medical department.

ECONOMIC READJUSTMENT FOLLOWING HEAD INJURIES

TEMPLE FAY, M.D., Philadelphia, discussed Economic Readjustment Following Head Injuries (see p. 362).

ATTITUDE OF THE RAILROADS TOWARD THE PROGRAM OF THE AMERICAN COLLEGE OF SURGEONS IN INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

HARVEY BARTLE, M.D., Chief Medical Examiner, Pennsylvania Railroad. The Pennsylvania Railroad has for some time emphasized measures for the prevention of accidents, for the most improved service in the treatment of accident cases to prevent extensive economic loss to the employee as well as interruption in production and service, and lastly for reconstructive surgery and placement of those who have become disqualified for regular service as the result of accidents.

We fully appreciate the importance of a collective expression in the traumatic surgery program. The American College of Surgeons is the organization that should take the initiative in such a problem necessary to secure the desired results. The Herculean character of the task should not deter industry from making an aggressive approach to the problem and with the assistance of the latest scientific developments attempt quickly to restore the injured to usefulness.

1 *First Aid*. We have carried on for years a program of first aid instruction to selected individuals in shops, and track gangs, to station employees, and train service men. This includes, in addition to first aid, instruction in resuscitation from electric shock.

2 *Transportation*. The major portion of our traumatic cases occur in shops or local centers and are cared for by our local surgeons or transported to hospitals in ambulances. There are, however, some who are taken on trains to distant points. The correct way of handling injured persons is covered in our first aid instruction to employees. We believe it is impractical, unwise, and a useless expenditure of money to carry on trains a lot of accessory equipment for the handling of injured persons. Our aim is to keep such apparatus and equipment at a minimum compatible with proper service.

3 *Co operation*. (1) The need of standardization is apparent for the classification of injuries in terms generally understood. (a) There should be uniform methods of diagnoses including X-ray and serological tests, (b) The most improved apparatus should be recognized and used, (c) The follow-up treatment is essential and should receive the most serious attention, (d) There should be a clearing house for all reports of accidents occurring on duty to consider cause, extent of trauma, progress, check by X-ray from time to time, if necessary, and reference to consultants when advisable. (2) The latest information available on the proper and improved method of handling traumatic cases should be generally disseminated to all members of the surgical staff. We attempt to use hospitals on the approved list. (3) While we endeavor to prevent results as far as possible that will require reconstructive surgery, cases do occur and we immediately refer them to

consultants in to l r putat n n plastic b ne and neur surgery

We tand r dy to pa t c pate n a pr ct calma ner w th p ram de el p d hy th Am rican Colle e of Surg ns I w b to thank the Ameri an Colle e of Surg s for th p v lege f sp k g for the P nn y l ania Railr d on th s subject

LABOR S INTERE T IN INDU TRIAL MEDICINE AND TRAUMATIC SURGERY

EDWARD F. McGRADY Rep e e tat ve Ame an F derat o of Labor The ubj ct e red s s g t d y s f inc eas ng impo tance to th w k g man Ah h e c tury go ma y f man fact ng p o c s es depend d l r g ly on th w k of the h ma ha d tod y powe m hinery has t k n ver th us ds f p o c s e wh ch f r me ly dep nd ed pon hum n s h l l With th s cha ge om s the k f ac de t f om heat relentles wh el e ol g at te f ic pe d f s t m i g h l t a d the da ger of molten metal d b u l g ch m al Tod v c g s a e r l l d by ma h n g l s b ttle e blow by m ch e g a t m ch e stamp t w h le autom b l e a m s r l l t s t p steel by the mile

These new p c s s e take a h avy t l l f l e a d l m b Ac dent stat t c s ho us that th d ath t e f r m a d t t i nd stry nea ly tw th t f r l l ther c d n t s wh h m v b e f l l a nd d u l I n r o g th ac id t l d th r t e p r o o o o nd try was 99 fr m l l o t h e c s e d d ing autom b l e ac de t s 57 I t s stum t d t b t 3 000 000 d u t a l c c i d e s t o c c u e a h y a r 4 00 f w h c h r e f a t l Los of k t m e f r m the yearly toll of c o u s pe m e a t d b l t h s b e s t m a t d a t 35 000 m n y c h i l e th l s s e r s j u e s p b b ly s u l s of 3 000 000 week w r k p e y a r

Cold figu show th h g da g t l e w o l f c e s b t h y c a n n t t e l l h a t t m e s t t h u s a n d s f f m i l e s w h t h b d w e r f i s t c o m h o m o w h h c m e s h m p e r m e n t l y d a s a b l d L s s o f o n l y m t h y n t a k b e v y t l l n s f l e g d a n e t y t y n t h n g i t h x p e f o m d c a l c a n d t h e l s s f g e s w h h m s t b e t k n f m i o d c l o t h g s m q u l l y e s e t a l t e m t h f m l y b d g t

O w o k r y 4 s f s d t a l c d t o f s m r t d u g t h y Th mea that c r a p o d f s h d l y s g l w l e n u n d t y w i l l c a p e t i t m c c d e t

Because f t h s r k h b v r y w o l m t a s s u m a h e t r s d t y l a b t a l l y t t d n y o u p g m t l y t h f d t n f r c l o e c o o p e t b t w n t h m m b f y r p o f e u n d t h e w h e d y r v i c s I f t h o k m y b v c u e t o c t t h m e d c a l n d s a g c a l c a r b e e d t t h t m f t h a c d t h u d d a s o f l s m y b s a d n d t h s a d f s m l l j n e s m y b p e a t d f r m b e c o m g s e o u s o r p m a e t l y d a b l n g

Not l n g a o d u s t r l c c d e t s d r e d a n u d a b l e d Th k t o o k t h

r k w h n h e e n t e d i n d u s t r y a d b o the t r g e r s u l t s B u t i n t h e l a t d c a d s t h e s a f e t y m e m t h a s h o h t a n e w p s t t h b e l f t h t t h e d a g e r f d u s t r y c n b e l r g e l y e l m n a t e d l d e r t h n e w d o c t n m a n y e m p l e n d i k e r s o g a z a t n s h v e e t t w o k w t h a l l t o e l m n a t e c e d e n t s a d t h m s t e c o a r n g r e s u l t s I t h P l l d e m e n t i n d u t r y 2 p l a n t s r e d I t h r a c c d n t f q e c y f o m 4 4 7 c i d s p e r o o 00 m a n h u s i n r o t 27 i n 9 5 a d e s f 29 p e c t a c c d n t f e q u e c y 6 y a r s M a n y n d v d a l p l t s s h o e m r e s t r k s g r o r d A p l n t n t h h e m c a l n d u t r y v h r s k s h i g h r e d c e d i t s a c c d n t f r q y f r m 67 8 t o 33 5 f r m 0 9 t o 9 5 E x a m p l e o f t h k d c l d b e m u l t p l d

Th e h s a l s b e u n v e m e t t o b g f i r s t a d n d m d c a l c e t t h w l e a t h k h a t h the n j u r y o c u The s e c o f a p l a n t d o c t o r f i r t a d o f f i c e u s f t h g a t e s t l m d a s n d e n w e k s f s f e r n m a y b e p e d t h e v i e t m f n c d t f b h a e a t o c e

A l o o k t t h e f t r e d e v e l o p m e n t f t h g t m v m e n t t o s a e l i f e a n d p e t f e u n c t i m p t a t a s p c t s t d t o a c m p l h t h e m t h o o p a t i n o f y r g n i s a t n a l l b e d d a d f l l g p e r v c m m n t y b o e n t e s t d h u m a v l f r e W m s t d e d i p c m m n t y p o t f f a c c d t p e e n t n a n d p o m p t f o t h t m f a d b l e j u r v

W e e d f i s t f a l l t o p s f w d t h g a t r e e g y a l n l n a l d y g e t d t h i n d u s t r i a l f e t y m v m t I p o r t t p o g s s h a s b e e m a d n a c d t p e t n n d p s f m d c l d u g c a l c a b t h d d l p l t s m p l v g m l l s o f w k r s h a e t j t b e e r a h d The m l l e p l n t p t c u l y s h o w t a d p t f e t y m s u s a n d t o r e c h t h e m n e e d m v i a s c m m n t y s p u r t f i s d u s t r l f e t y l p r m f e o p a t o n b t w e e

m m b e r f y o u p r o f n d m m t v g r o u p a s u d a m n t a l l t c a b e d l p d t p o w e r f u l m v m e t b g t h p t c a l m u t o t h s e w h o n d t s o l v t h o k e r a t h b n c h t h e f c t r y t h e s t c a r p t t h e t d r n e t h e d a n s o l t f i c t h e b u i l d i n g t r a s m a n t h e d i z y b e g h t f t h e m d m k y s e p r T h e s a f e t y m m e t b d d a l l c l u s The s t g l e m m b e r f a y c o m m t y w h d e s t n e e d t k t h d n g s f a c c d t h h n d h u m t k d a i l y l l e n d h m y a t a n m m t n d m d c a l r r g c a l h l p

A n a m m t f r d t r i l f i t y w l b e s u c c f l l f a l l g r u p c m b t h e u r f r t s The c o p a t n f w k s i p t c u l y m p t t T h e r n o g a z a t n t h e t r a d u g e t h e m t m n f e t b t t h d d g g t n s t m l e p g m p e t c l I t f r m a s t h m n o f r a h n g c h d d l w k t d c a t e h m n h b t f s f t y t w k d s e c u e h c o o p e t Th k r o o p e t n a d d e r s t a d i n s t a l o s a f t y c m p g n c a c e d w h o t

it The trade union can mobilize the workers' intelligence, initiative, and interest

Short hours of work and a living wage are important promoters of safety, for accidents are more frequent with fatigue, low morale, and the physical deterioration of long hours and low wages. By setting standards for shorter work hours and higher wages, trade unions are already making a significant contribution to the safety movement.

As we consider various problems of promoting industrial safety, one stands out in particular that of providing adequate safeguards against the dangers of new industrial processes. With the onrush of new inventions, new machines and processes are constantly being introduced into industry. We do not want to try them out with human loss of life or health before we discover their dangers. But too often no one takes the trouble to provide against the worker's injury when a new process is introduced. The paint spraying machine has cost heavily in cases of poisoning and loss of health, unguarded machines took untold lives in the metal industries, the dust from stone cutting machines caused lung trouble for thousands of workers. In work with all these and many other machines, workers paid a high price in loss of life and limb before the needed safety devices were introduced. We need to control new processes as they are introduced to make sure that the worker will be protected.

A particular danger is in the increasing use of chemicals in industries. We all know the heart-breaking record of the phosphorescent match industry and of the radio active substances used for illuminating and other processes. Many of the chemicals just being introduced in new processes contain insidious poisons which may undermine workers' health. These should be studied before they are introduced in the production process and the proper safeguards provided.

Education is also essential. We need to develop the safety habit, which means first showing the worker the dangers which surround him and then teaching the safeguards until the habit of doing things safely becomes subconscious. Here again the worker's co-operation is necessary.

An important part of the safety habit is the use of proper care immediately after an accident occurs. The worker should be conscious of the medical and surgical facilities his community affords and know how to obtain them. The problem of expense should be carefully considered by the community where industrial medicine and surgery are needed, for often the high cost of medical care keeps workers from getting the immediate attention they need.

To lessen the terrible toll of industrial accident is one of the great humanitarian tasks of our times. A good start has been made, but the task is only begun. It involves intricate problems, industrial on the one side, medical and surgical on the other. It will require close co-operation, careful study, sincere devotion, and patient work. But what task in this age of the machine could be more worth the effort?

OUR RECOGNITION OF THE IMPORTANCE OF ORGANIZATION FOR THE CARE OF MEN AND WOMEN IN LARGE INDUSTRIES

E F CARTER, Vice President, American Telephone and Telegraph Company. Along with the great expansion and concentration of business operations, there is entering more and more into the business idea the thought that consideration of the human unit to improve mental and physical productivity involves advice in periods of peace, stress, health, or sickness, and carries with it improved morale of workers as well as improved results in business operations.

Business, of course, has been aware of its responsibilities entirely apart from the question of the costs of medical and surgical care when employees are injured in the performance of their duties. The introduction of medical work in industry for the purpose of bettering production and happiness, as we see it, has come about as a result of the requirements which accompany the centralization of productive effort.

There have been at work various subtle social forces which have expressed themselves in different ways in the several industries. The Bell telephone companies in 1913, established and placed in operation a disability benefit plan. The company is the sole contributor. Employees when ill or injured benefit by payments regulated by wage scale and length of service. It developed, as time went on, that there was a distinct medical phase to the administration of the benefit plan, and medical people were gradually taken into the organization in various parts of the country. These doctors, at first, only advised those officials who had charge of the administration of the plan, but there has taken place a very natural evolution in the medical work connected with the plan so that the doctors in many of our companies now examine candidates for employment, give periodic examinations, examine employees after disability, and assist in health educational activities. We recognize now more clearly than ever before, the business advantages which result from an interest in the physical state of employees and that such an interest wisely and discreetly exercised is an important function of management. We have watched all sorts of medical work in industry, from the ultra-altruistic types to the ones based on plain common sense, and it is our belief that the introduction of medical work, while of the utmost value to the personnel, should be justified solely as good business. We do not assume the responsibility which belongs to each man and woman to look after his or her health or to decide what kind of medical advice to take, nor do we assume any of the responsibilities of the family doctor.

The question of health maintenance has introduced into the sickness problem of communities a feature which is only partially appreciated by the public, and which in all fairness can be no more than

part ally borne by the medical prof s on The pub
l c o ganizat ns su h s health departm nts
natu ally bear the gr ater p t of the haza dous
burden f health m i tenance such s wholesal
imm nizat on ep dem c s feg a ds th The
educ t on l and d gn st c f atures of the inc e s
i gly popular subject sh uld find a eady sympathy
in the busness e cutiv exercising supervisory
powe s o r larg e oups of employee

It i n t ou polcy to carry on the t eatm nt of
dls ase o whe e adequate s cal talent s avail
abl the tre tment of c dent cas s In matte s
f t eatm nt first aid s ou immediate objectiv
and r spons bilty w th in add to a upervisory
cont ol of such an extent as to as ur r asonably
c r ect d i gnos es pr pe su g cal ca ho p taliza
t on and rehabl itation

We do tra n o r w rkers t understand first aid
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turn t w rk nd c t nue at w rk d (z) thr u h
the appl cat on f mmedately diagn st c f f t to
plac information concern glat nt or act d i eas
n the hands f the empl y es med cal dv sor

We heli ve that it is m ney ell pe t and
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the benefit plan to know what our m ney s spe t
lo in lnes and; ccd nt both dur ng the acute
phases as well a dur ng c nvalescenc a d to know
that th company the doct r and empl yee ar ll
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System s not practi ng m d c e n do s the
m d c l w tk w d repl ce the nt rest of the b s
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tions under which they work must be safeguarded. It took a fire causing the death of over a hundred young working girls and the injury of scores of others to make New York State study carefully the provisions for the safety of industrial workers. After a legislative inquiry lasting 2 years, New York State passed the most enlightened labor law of any state in the Union.

Safeguards against fire, protective sanitation, proper ventilation, and similar provisions were looked upon not merely as legal safeguards but as actual preventive measures. The law limiting the hours of labor in factories and mercantile establishments and the law prohibiting night work for women were not merely restrictive measures but instruments which met the constitutional test in our appellate courts because they were declared to be measures of public health.

As a matter of fact public health seems to me to be of importance to the people as a whole and I would like to see some system whereby health information and proper medical treatment would be available to every man, woman, and child, regardless of position in the world, whether this be done through some form of health insurance or through a widely established system of public health clinics, acceptable to every type of community, rural as well as city. It is only a few years since I was able to demonstrate to the leading physicians of New York State who came from every part of the state to attend a conference at the executive chamber, Albany, that rural health was being neglected and that the state must be protected in safeguarding it. As a resolution we passed a law enabling the state to contribute 50 per cent toward any health work undertaken by the county. The success of this effort has been well established. Many counties not

hitherto encouraged to undertake any public health work have done so. The lesson in the preservation of human life has been best illustrated in Cattaraugus County where an experiment was established, utilizing every conceivable health resource in that county, both public and private. It was co-ordinated and made to function so that every child came under its influence, even before it was born, and so that every adult came under its influence until the last of his days.

We have traveled far in learning new methods of caring for the public health. In the last 25 or 30 years we have learned the meaning of preventive medicine and we have learned more about the causes of disease. But it is difficult to carry knowledge to every home. Too many people are still ignorant of the importance of calling a physician. They do not realize the importance of that early stitch which saves nine others. Such a body as this can do much to further disseminate that knowledge. There is no asset of the state above and beyond a healthy citizenship. Health begins before the cradle in the care of the mother, and then of the infant from the hour of its first breath.

We found at the time of the war when we made careful health examinations that 33 per cent of the young men suffered a physical defect which could have been cured had they received attention in the early years of their lives. How much of this has since been corrected is hard to say. Only by constant effort and the constant dissemination of knowledge to the public can we hope to progress along these lines. Your organization must lead the way by giving us the scientific facts with which we can deal. But the State, using that word in its largest sense, must fix those facts into effective, administrative action.

COMMITTEE AND DEPARTMENT REPORTS

DEPARTMENT OF CLINICAL RESEARCH—ALBERT J. OCHSNER MEMORIAL

THE London Assurance Co. Ltd. has been conducted by the College of Insurance, which follows the committee.

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SURGERY (GYNECOLOGY AND OBSTETRICS 03)

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The Committee on the Treatment of Malignant Diseases has previously published five-year results of treatment of cancer of the breast and of the cervix, and the continuation of the studies of these cases and of cancer of other parts of the body is being continued and the results of the study will appear from time to time. The fact that we have complete records of a number of cases in which the patients have lived from 5 to 20 years after treatment—71 in the case of cancer of the cervix, 105 in the case of cancer of the breast, and 57 in the case of sarcoma of the bone—when added to the authenticated reports from many clinics in different parts of the world justifies us in making the definite statement that cancer of many parts of the body, if treated in time, may be successfully treated. There are academic questions that may arise in this connection but they in no way invalidate the statement, and this is a fact of which we wish to convince both the skeptical medical profession and the uninformed public. An examination of our analysis of about 50 cases of malignant bone tumors that have lived for more than 5 years following treatment should be convincing, even though some few of the cases may lack data which might be demanded by pure science.

There have been submitted to the Registry of Bone Sarcoma during the year 179 cases of which 123 have been registered. The activities of this Committee are submitted in a separate report.

The report of the Committee on the Treatment of Fractures is submitted separately.

In April, 1930, a committee was appointed for investigation of methods of treatment of cancer. This committee rendered a report a year ago and is continuing its observations.

The research on the use of the electrosurgical unit which has been conducted during the past year and a half under the auspices of this department has had the co-operation of 660 surgeons, who have furnished reports to the College on its use in 3,470 cases. These cases include involvement of practically all parts of the anatomy by a wide diversity of disease conditions.

It is natural that surgeons who restrict their activities to certain anatomical parts of the body have based their conclusions upon experience in their own specialty. However, the large number of reports from such a large group of surgeons as have co-operated in this study may be expected to eliminate the element of prejudice. There are certain cases in which the electrosurgical unit has been used as the sole instrument, while in other cases it has been used as an adjunct to the scalpel. There is a certain number of questions which inevitably arise in considering the usefulness of this type of surgery. Is it possible to accomplish with this instrument that which it would be impossible to accomplish otherwise, or are the results better than otherwise obtained? Experience has shown that certain things are possible by the use of this instrument which otherwise could not have been accomplished.

In a more general way it is essential to know whether or not postoperative hemorrhage, infection, and pain are more or less frequent and whether the time of wound healing is hastened or delayed. Is the time required for operation diminished? Are the end-results such as to justify the use of this instrument?

There are certain advantages in the use of the electrosurgical unit which are universally conceded whatever the part of the body involved and whatever the disease may be. These advantages are its asepsis and the ease and rapidity of inducing hemostasis and avoiding the use of a large number of ligatures. An advantage for it is claimed in the case of malignant tumors in that it seals the blood and lymphatic vessels and prevents dissemination of tumor cells. The period of the experiment has been too brief to give absolute proof of this claim. The ease with which hemostasis may be produced makes it possible to perform operations on parts in which the use of ligatures would be difficult and at times impossible, as in operations on the central nervous system and in places that are so difficult of approach as the pharynx and larynx.

It would be of no benefit to enumerate all of the diseased conditions in which this instrument has been used in the course of our investigations but, in summary, it may be said, in answer to the query as to the types of cases in which its use has advantages, they are brain tumors, as an adjunct for production of hemostasis, in cancer, especially in massive removal of the breast, in thyroid operations, for the production of hemostasis, removal of large portions of tissue, such as in amputations, in certain intracranial and intrapharyngeal tumors, for removal of circumscribed cutaneous lesions, for opening the stomach and intestine, in endocervicitis, in hemorrhoids, in hiopisies. Its advantageous use is not restricted to these conditions but they are the ones to which the most prominence has been given by those who have participated in the research.

With regard to postoperative pain, the evidence is in favor of a statement that this is lessened. The majority express the opinion that they have observed no advantage of electrosurgery over the scalpel with regard to postoperative pain, but there is a considerable number of surgeons who are convinced that the postoperative pain is lessened and some of them say very much lessened. None has considered postoperative pain to be increased.

With the question of wound healing the reverse is the case. While a few men note no delay in wound healing, the majority have found the time of wound healing to be somewhat prolonged, but in very few cases has this delay been sufficient to contraindicate its use.

As regards secondary infection the evidence is not conclusive. A decision on this subject would require more accurate data as to the type of cases and the condition under which the operation was performed. The investigators in this research have not indicated an increase in the frequency of secondary infection.

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In the exhibit at the Congress this year the emphasis is on the striking graph of the life expectancy on which the verb is used to describe the of the primary neoplasms, the Registry that serve to show the graph and the striking manner in which the sets of pedicels in the foreground of the Ewing's sarcoma are the giant cell tumor.

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surgical instrument manufacturers, and hospitals have been notified of this action. The surgical profession is gradually being informed through appropriate channels of the existence of standard steel bone plates and screws. A standing committee representing the manufacturers, distributors, and users has been designated to have charge of any further revision of the standard.

The Sub Committee on the Use of the Fluoroscope, consisting of Doctor William L. Estes and Colonel William L. Keller, has rendered its report and it has been published in the *Bulletin of the American College of Surgeons*, 1931, xv, 2. One thousand reprints of this report will be distributed at the Clinical Congress.

The Sub-Committee on the Moving Picture Film on the Treatment of Fractures has submitted the scenario to the Eastman Teaching Films, Incorporated, and at present has no further report.

The Sub Committee on Fracture Organization has also rendered its report. It has been mimeographed and is in constant use. One thousand copies will also be distributed at the Clinical Congress.

The Sub-Committee on Medical Education, consisting of Doctors William Darrach, Frederic J. Tees, and Isidore Cohn, has been very active concerning undergraduate teaching in medical schools, graduate teaching, and the instruction of internes in the treatment of fractures. The report of this committee has been sent to approximately 2200 approved hospitals in the United States and Canada and to the professors of surgery at the various medical schools. Numerous hospitals have advised us that they have whole-heartedly adopted the recommendations of this committee, and others that they are in entire accord with these recommendations.

The Sub Committee on the Ambulance, consisting of Doctors Robert H. Kennedy, Philip H. Kreuscher, and Colonel William L. Keller, is at present at work upon the standardization of ambulance equipment for the treatment of fractures and instructions to ambulance drivers and internes. It is anticipated that this committee will succeed in establishing more uniform and better treatment for these acute injuries.

The National Board of Medical Examiners and the Federation of State Boards are actively interested in including questions on fractures in their several examinations of candidates for licensure.

The American Railway Association has a permanent fracture committee which has accomplished considerable work during the past year. This group is manifesting great interest in the work of the Fracture Committee to improve the handling of fractures on the railways of this country. There are approximately 300 chief surgeons and 10,000 railway surgeons who are now handling these injuries in various ways and are looking to our committee for suggestions.

The American Red Cross requested the assistance of the general fracture committee in rewriting the

section on fractures of their *First Aid Manual*, and this has been accomplished. The suggestions of the committee have been accepted and will appear in the next edition of the *Manual*, which is just being published. This puts the committee in touch with hundreds of first aid classes throughout the country.

The annual Fracture Oration was given last year by Dr. Dallas B. Phemister, professor of surgery at the University of Chicago, the subject being "Splint-Grafts in the Treatment of Delayed Union and Non-Union of Fractures." The oration this year is to be given by Dr. William Darrach, New York, professor of clinical surgery, Columbia University.

It thus appears that the general fracture committee is composed of 40 surgeons keenly interested in the improvement of the treatment of fractures, and co-operating with it there are approximately 150 surgeons constituting the 25 regional committees. These men, by making contacts with several agencies, namely, medical schools, hospitals, the American Railway Association with its surgical personnel, the Bureau of Standards at Washington, D. C., the Board of Medical Examiners, the American Red Cross etc., by educational methods are slowly but surely raising the standards of fracture treatment.

Standard for Minimum Equipment for Fracture Treatment in Hospitals

- 1 That all general hospitals be equipped to care for fractures, that the minimum equipment for the transportation and emergency treatment of fractures be the following or its equivalent.

Thomas upper extremity splints, Thomas lower extremity splints with traction straps, slings and buckle straps, Hodgen splints, coaptation splints, assorted sizes, Cabot wire splints, straight pieces of wood (of assorted length, width and thickness) for splints, plaster-of-Paris bandages, some form of overhead frame for suspension, suitable X-ray apparatus, including a portable machine, if practicable.

- 2 That it is highly desirable that one individual surgeon be responsible for the supervision of the care of fractures in each hospital service.
- 3 That special record sheets be used for fracture cases.
- 4 That a close follow up be maintained on all fracture cases for such time as necessary to establish an accurate knowledge of end results.

The personnel of the Committee on the Treatment of Fractures is as follows:

Charles L. Scudder, Boston, *Chairman*

Frederic W. Bancroft, New York, *Secretary*

Nathaniel Allison, Chicago

Willis C. Campbell, Memphis

Isidore Cohn, New Orleans

H. Earle Conwell, Birmingham

and given effective treatment during the early and curable stages of the disease

The personnel of the Committee on the Treatment of Malignant Diseases is as follows

Robert B. Greenough, Boston, *Chairman*

A. C. Broders
Rochester, Minn.

Curtis F. Burnam,
Baltimore

George W. Crile, Cleveland
Bowman C. Crowell,
Chicago
William Duane, Boston
Edwin C. Ernst, St. Louis
Rupert H. Fike, Atlanta
John M. T. Finney,
Baltimore
Burton J. Lee, New York

Frank W. Lynch,
San Francisco
Robert T. Miller, Jr.,
Baltimore
Henry K. Pancoast,
Philadelphia
H. Gideon Wells, Chicago
Francis C. Wood, New York

BOARD ON INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

FREDERIC A. BESLEY, M.D., WAUKEGAN, ILLINOIS

Chairman

IT is gratifying to report that as a direct result of a keen interest and the active initiative on the part of Dr. Franklin H. Martin, the Director General, in the work of the board, it has been able to accomplish results that it is believed will be far-reaching in effectiveness in securing advancement in this department of medicine and surgery.

As a first step it was deemed advisable and desirable to establish a contact with as many large industrialists as possible and to secure their active correlation and support in this work. Appreciating the fact that many industries were operating their own clinics, some of them doing good work and some of them doing most indifferent and inefficient medicine and surgery, the Board formulated a minimum standard for industrial clinics

- 1 That the industry shall have an organized medical department with competent medical staff including consultants and adequate emergency dispensary and hospital facilities and personnel to assure efficient care of the ill and injured
- 2 That membership on the medical staff shall be restricted to physicians and surgeons who are (a) graduates of scientific medicine holding the degree of Doctor of Medicine, in good standing and licensed to practice in their respective states or provinces, (b) competent in the field of industrial medicine and traumatic surgery, (c) worthy in character and in matters of professional ethics, that in the latter connection, the practice of the division of fees under any guise whatsoever be prohibited
- 3 That there shall be a system of accurate and complete records filed in an accessible manner—a complete record being one which includes identification data, cause of illness or injury, nature and extent of illness or injury, detailed description of physical findings, special examinations such as consultations, clinical laboratory and X ray, tentative or provisional diagnosis, treatment, prognosis with estimated period of disability, progress of illness or injury, final diagnosis, condition on discharge, end-results, and such additional information as

may be required by statute for Workmen's compensation claims or for other purposes

- 4 That all patients requiring hospitalization shall be sent to institutions approved by the American College of Surgeons
- 5 That the medical department shall have general supervision over the sanitation of the plant and the health of all employees

Two excellent men, Dr. Williamson and Dr. Newquist, were employed to make a survey of the industrial and other types of clinics to ascertain which ones conform to the minimum standard which has been established by the Board. These men have done splendid work.

There have been surveyed, reported upon, and the records carefully analyzed, 174 clinics of which 84 are approved as meeting the minimum standard.

In a large majority of instances the leaders of industry have shown a deep interest in the program the College has formulated and is attempting to execute, and they have been most co-operative in their attitude toward the investigators. A large amount of data has been secured which will furnish facts and figures for a basic study of this vast and important situation and a knowledge of all these circumstances will place the College in a position to influence and direct some rational plan for improvement in the care of traumatic cases.

One interesting observation that was made was the real desire the industrialists expressed for the approval of the College for their individual clinics. Obviously, this is important for it furnishes the impetus for raising standards.

The personnel of the Board on Industrial Medicine and Traumatic Surgery is as follows

Frederic A. Besley, *Chairman*
Bowman C. Crowell, *Secretary*

J. E. Bacon, Miami, Ariz.	Thomas G. Orr, Kansas City
Samuel R. Cunningham, Oklahoma City	W. O'Neill Sherman, Pittsburgh
Donald Guthrie, Sayre, Pa.	Loyal A. Shoudy, Bethlehem
Lucian H. Landry, New Orleans	Ernst A. Sommer, Portland
A. D. Lazenby, Baltimore	Henry A. Staib, Chicago
C. F. Martin, Montreal	Frederick J. Tees, Montreal
Charles H. Mayo, Rochester, Minn.	John B. Walker, New York

REGISTRY OF BONE SARCOMA

BOWMAN C. CROWELL, M.D., CHICAGO

R

I HAVE the honor to submit the following report on the Registry of Bone Sarcoma.

There have been submitted to the Registry of Bone Sarcoma during the year 1909 cases of which 13 have been registered. Five hundred and forty-eight case records have been sent around among 6 men and their physicians on these cases have been furnished to the surgeon who registered the cases. The Registry has been considerably used during the year as a consulting bureau on bone tumors as surgeons, pathologists and radiologists have sent for most noncurrent assistance in a to-day's case and advice as to treatment. There are now 172 cases in the Registry. Faculties of museums on this subject at the College have become available and a considerable number of specimens have been mounted and are on display with the complete record including x-rays and sections of the case. The files of these files for study of the complete case are becoming more and more utilized by the surgeon, radiologist and pathologist. The number of gross specimens that we are receiving is not so great as we would like but increases each year. There has been no meeting of the committee

this year but the work which has been done in the last meeting of the committee has been prepared for publication and within a few weeks there will be published a critical analysis of the year's work, with discussion on contraindications.

Two Chicago surgeons are now pending 3 half days a week in studying the material of the Registry, and making detailed reports on gross specimens before mounting.

The personnel of the Committee on Bone Sarcoma is as follows:

	D. I. B. Th. M. T.	Ch. G. Ch. M.
	B. W. M. C. C.	D. C. B. G. R. G. T.
Ed. I. B. T. T.		W. R. Galbreath, Jr.
S. F. C.		R.
J. P. C. D. D. d.		F. A. W. H. T. M.
B. H. M.		D. T. T.
B. M. Y. B. T. N. H. W.		H. W. M. Y. D. B.
F. M. T. A. C. D. M. B. T.		R. H. T. M. A. S.
Ch. T. S. L. C.		J. H. J. M. T.
S. F. R. A. C.		R. H. T. V. Y.
J. M. E. G. H. W. Y. K.		L. R. A. T. T. V. S. T.
	Ch. G. C. Simm.	D. T.

STATE AND PROVINCIAL SECTIONAL MEETINGS

SEVEN sectional meetings of the College have been held since January 1, 1931. These meetings are becoming increasingly effective in stimulating clinical surgery, hospital betterment, scientific medicine, and in informing the public on matters pertaining to health, disease, scientific medicine, and hospitals. The meetings are planned in such a way as to give emphasis to each of the four named activities of the College. Clinical surgery receives its stimulus through the holding of surgical clinics by local surgeons on each morning of the 2 day meeting. Hospital betterment is the subject of constructive discussions and presentations during the entire 2 days of the meeting. Advances in scientific medicine are presented by clinical addresses during the noon hour on each day and scientific papers on the afternoon of the second day of the meeting. On the evening of the first day of the meeting a banquet is held at which are presented silent and talking medical motion pictures prepared under the auspices of the Board on Medical Motion Picture Films of the College.

The education of the laity in matters pertaining to health, disease, scientific medicine and hospitals constitutes one of the major activities during all meetings. Several agencies are employed for this purpose. The lay press is furnished with numerous articles on scientific medicine, prior to and during the meeting, and with numerous interviews by visiting speakers during their sojourn in the city in which the meeting is held. Health talks are given to the children through the courtesy of the departments of education who make it possible for visiting speakers to present their subjects at assemblies in auditoriums of the high schools for periods of 20 minutes to 1 hour each. The number of high schools at which such talks have been given during this series of sectional meetings has been as high as 20 in some cities, and the number of high school children addressed ranges from ten to fifteen thousand in each city. Numerous health talks are broadcast over the radio, and a community health meeting is held in each city. At these meetings the visiting speakers presented their subjects to audiences, which varied from one to three thousand.

The noon day service clubs and chambers of commerce have co-operated wholeheartedly in furthering this lay educational program and speakers have appeared before outstanding clubs of this nature.

A preliminary visit to the city by an official of the College results in stimulating interest in the ensuing meeting and in the formation of a local committee of arrangements who are then presented with a general outline of the character of the meetings, along with suggestions as to the methods that experience has taught the College to be most suitable for procuring the desired results. The wholehearted co-operation of the local fellows of the College in making the arrangements for the meetings has been reflected in the very successful sessions which have been held this year.

An unusual feature of the sectional meetings in 1931 has been the holding of a 3-day sectional meeting in Oakland, California, with the participation of seven states and one province. At this convocation two large community health meetings were held. This constituted the largest sectional meeting which the College has held.

Sectional meetings have been held in 1931 as follows: Missouri, Kansas, Iowa, St. Joseph, January 5-6, Arkansas, Oklahoma, Texas, Little Rock, January 9-10, Louisiana, Alabama, Mississippi, Florida, Georgia, New Orleans, January 12-13, Kentucky, Tennessee, Nashville, January 16-17, Ohio, Indiana, West Virginia, Cincinnati, January 19-20, Nebraska, Lincoln, February 9-10, California, Nevada, Arizona, Idaho, Utah, Oregon, Washington, British Columbia, Oakland, April 23-24-25.

The visiting speakers at these meetings included: Doctors Alfred W. Adson, Rochester, Frederic A. Besley, Waukegan, Virgil P. Blair, St. Louis, Joseph C. Bloodgood, Baltimore, Louis H. Clerf, Philadelphia, George W. Crile, Cleveland, Bowman C. Crowell, William R. Cubbins, Irving S. Cutter, Chicago, Frank D. Dickson, Kansas City, Frederick C. Herrick, Cleveland, George J. Heuer, Cincinnati, Harvey J. Howard, St. Louis, Edward Jackson, Denver, Allen B. Kanavel, Philip H. Kreuscher, Chicago, Burton J. Lee, New York, Paul B. Magnuson, Franklin H. Martin, Malcolm T. MacEachern, Chicago, James R. McCord, Atlanta, C. Jeff Miller, New Orleans, Harry E. Mock, Chicago, Gordon B. Nev, Rochester, Alton Ochsner, New Orleans, Max M. Peet, Ann Arbor, Harry L. Pollock, Chicago, T. R. Ponton, Augusta, Arthur W. Proetz, St. Louis, Harry M. Richter, Chicago, Judge H. M. Stephens, Berkeley, and Robert Jolly, Houston.

THE CREDENTIALS COMMITTEES AND COMMITTEE ON HISTORY REVIEWS

DWIGHT F. CLARK, M.D., E.A. O. ILLIN.

THE procedure of admitting candidates to Fellowship in the American College of Surgeons requires that each candidate after filing his application be recommended by his State or Provincial Credentials Committee before proceeding further with his paper. In each state and province there is a Credentials Committee composed of fifteen members who are Fellows of the College elected to serve on the Committee by the Fellows of the College of the respective state or province for a term of three years. Half of the Committee being re-elected each year.

No candidate is admitted to Fellowship without the recommendation of his State or Provincial Credentials Committee.

The members of the Credentials Committees generally of this term and meet at a designated interval in the state or province at least once a year and review the credentials of all candidates whose applications are pending from that respective state or province. Much credit due the Credentials Committee for the report the work of the selection of the men who compose our Fellowship.

After a candidate is selected who has been recommended by the Credentials Committee his representative on the State or Provincial Credentials Committee records the College's recommendation in a major book by himself and so which he is then responsible to suggest and suggest abstract of major work which has a standard which he has done himself. The record is a carefully made by the Credentials Committee to review proposed future standing regulations in the field of the general practice of medicine and surgery and medical education in Chicago.

This year 62 of histories recorded and of that number 58 is 58800 divided by the way we are and it is by the Committee history

review. There remains 33 sets of the committee as the applicants had to try to be elected properly. The State or Provincial Credentials Committee of the review would set we accept and 70 sets we not accepted. Those who's history is not accepted have the privilege of filing a rebuttal and additional history.

Twenty committees were held by the Committee history review for the purpose of studying the histories and during the 4 weeks preceding the meeting many additional hours were spent by the members of the Committee in order that every candidate's records could be discussed and might be reviewed.

The records half of which were to be set aside of major portions performed by the candidate and the other half abstract cases which they had prepared upon the major or the highest history had been reviewed checked the most accurate particularly with respect to the preparation of the candidate though the history which the case was studied the technique and the standard.

The history which were recognized as being unusual merit were gathered and the subject of a special review of the Committee and left the selection of those who have been recommended in the standing of the Committee's curriculum of professional merit and merit of the candidate.

The members of the Committee on history are so honored they are

James H. Blumh
D. H. F. C. L.
Harry C. L.
F. N. E. D. d
Joseph E. F. t. edit
Henry J. L. so
Oscar J. A. ft
Philip H. K. sch

Gold L. M. Whit
G. J. M. gr
Oscar L. d
R. d. J. E. Od
Ch. I. H. P. k
Chas. H. P. d. r
(E. V. Allyn

MEDICAL MOTION PICTURE FILMS

J BENTLEY SQUIER, M D, NEW YORK

Chairman

THE co operation of the American College of Surgeons and the Eastman Kodak Company (through its subsidiary, the Eastman Teaching Films, Inc) in developing the production and use of motion picture films for teaching medicine and surgery, has resulted in the release of four new films during the past year. Seventeen such films have been completed, approved by the College, and are now available to the medical profession. With two or three exceptions they are made in both the 35 millimeter and 16 millimeter size, and may be rented or purchased by any professional group or individual.

Four additional already-existing films have also been approved, subject to satisfactory minor changes.

More than one hundred reels of films produced independently by other organizations and individuals have been reviewed at the office of the Board in Chicago during the year.

The Board is keenly interested in developing the production and use of talking films. During the past year improvements have been made in recording methods and in projection equipment that will be important factors in the application of this medium to the teaching of medicine and surgery. Much time and thought has been given to plans for active co operation with some of the organizations that are especially interested in this phase of the work.

Film exhibitions are an important and popular feature on the program at the Clinical Congress each year, and at all sectional meetings of the College. A number of special showings that have been given to demonstrate the value of motion pictures for use in nurses' training schools indicate a very definite interest in films suitable for this purpose. Several articles discussing the application of films to various branches of medical teaching have been published in the *College Bulletin*.

THE LIBRARY AND DEPARTMENT OF LITERARY RESEARCH

WITH June of 193 the Library directors alluded
 Department of Literary Research and Economics
 completed ten years of service in behalf of the
 Fellows of the College. At the time of its receipt in
 the Library consisted of the very splendid collection
 assembled by Dr. John B. Murphy as gift to the
 College through the generosity of Mr. Murphy.
 This collection of some thousands of volumes
 included many of the best of recent scientific liter-
 ature representative of the fields of anatomy, physiology,
 and pathology. The original portion of the Library
 included notes and collections on onychophoran
 abdominal and genital anatomy, and in addition
 the best of the general anatomy monographs.
 With this very fine collection included the
 Library has increased its annual income. In
 1935 the John B. Murphy Memorial Building was
 erected and the Library was moved to the new and
 spacious quarters the property of the building.

Through the generous assistance of the
 staff of the Fellows the collection has been
 developed. The Library first fall a deposit
 for the work of the Fellows. Each Fellow there
 fore has been asked to present a copy of his
 book and two reprints of a historical work
 written. The response to this request has been
 satisfactory. During the past year more than
 twenty hundred reprints have been presented to
 the Library. These with the materials previously
 have been secured as a worthy presentation of
 the literary and scientific work of the Fellows. The
 monograph has been placed on the open shelves
 of the reading room where they are available to
 visiting Fellows for reference. The reprints are
 added as copy being placed with the Fellow's file
 as a permanent record of his work. The inter-
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During the past 10 years, the international collections have been contributed to *Osteoderm* magazine these are the H. W. Miller Collection and the Hyatt

cysts the ophthalmological library of the late Dr. Orin LeR. J. Smith and the extensive accumulation of old references obtained through the interest of Dr. Hamilton Still on Seattle. The bound journals largely financed contributed by Dr. George N. J. Sommer Trenton and the gifts of Drs. E. L. K. New Orleans, Mary McE. Chicago, P. E. St. Clair and William M. Thompson Chicago have been incorporated in the series so that the resulting shelves of useful material are in the College Library contain the personal library of Dr. Albert J. Ochner together with the printed and manuscript material of his associates as well as his unique position in the surgical field. A new general restnadaction bibliography of the College.

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DEPARTMENT OF LITERARY RESEARCH

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been furnished to individuals and to committees and clinics to aid in the preparation of papers, the study of clinical cases, the development of experimental work, or to meet any other need which may arise. No Fellow of the College is located at too great a distance to receive the benefits of this service, no request is too comprehensive or too

trivial to receive the careful attention of the staff. A brochure descriptive of the plan of the Department will be forwarded upon request. It is the aim of the Department to render a complete and satisfactory service in this field and to cooperate fully with any Fellow who is in need of service.

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Vice-Presidents C. Gordon Heyd, New York,
W. Edward Galhe, Toronto, Ontario

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Regents for term expiring in 1933 Ernst A. Sommer, Portland, Oregon, John E. Jennings, Brooklyn.

Members of the Board of Governors for term expiring in 1934 Guy Aud, Louisville, David W. Basham, Wichita, Kansas, Alexander W. Blain, Detroit, John J. Buchanan, Pittsburgh, Thomas O. Burger, San Diego, John E. Cannaday, Charleston, West Virginia, Robert S. Cathcart, Charleston, South Carolina, Marshall Clinton, Buffalo, Malvern B. Clopton, St. Louis, Walter Gray Crump, New York, William C. Danforth, Evanston, Illinois, Juvenal Denegri, Lima, Peru, John Dean Elliott, Philadelphia, Curtis A. Evans, Milwaukee, Wis.,

Lil an K P Farrar N York R E H lahan
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HOSPITAL STANDARDIZATION

REPORT OF 1931 CONFERENCE IN NEW YORK

THE papers and discussions given at the Hospital Conference held during the Clinical Congress of the American College of Surgeons in New York and Brooklyn, October 12-16, 1931, are presented in abstract form in the following pages. Inasmuch as manuscripts of all the papers and discussions were not available, the full scope of the program is not indicated by the abstracts here presented. Papers will be published in full in the *Bulletin* of the American College of Surgeons and other journals during the coming year.

THE OBLIGATION OF THE HOSPITAL TO THE INTERNE STAFF

C. JEFF MILLER, M.D., New Orleans. In the near future the minimum standard for hospitals must be substituted by a maximum standard in which the criterion will be increased emphasis on the type of staff, particularly a staff equipped and willing to furnish the training which a medical graduate has a right to expect in his interne year. Internes are regarded too often as persons whose function is to relieve the staff of routine tasks, whereas they should be considered chiefly as advanced medical students. They need no further didactic instruction but they do need to be trained in the clinical aspects of the medical art. It is the responsibility of the hospital staff and the hospital administration, therefore, to see to it that the internes are given the sort of training which will equip them for their future professional careers.

It must be kept in mind that the interne is not in the hospital to learn surgery. He should be made to realize by the example of the staff that the practice of surgery requires long, specialized training. No hospital should permit first year internes to do surgery independently, even under the strictest supervision, and it would be better if the privilege were not extended even to second year internes. The present light hearted attitude of young men to undertake surgery is largely the fault of their seniors, who have permitted them in their training to operate independently and who have allowed them to believe that such experience is all that they need to set themselves up as independent surgical specialists. It should be remembered that the internes being trained today are the physicians and surgeons of tomorrow and that therefore they must be taught not only the mechanical and material side of medical practice but the ethics of their calling and the ideals of their art.

SOCIAL IDEALS IN HOSPITAL SERVICE

ALLEN B. KANAUEL, M.D., Chicago. There are two critical tendencies apparent today that should leave no true friend of medicine and the public without concern. These are, first, the great increase in the number of quack physicians and faith healers and, second, the complaint of the mounting cost of medical care.

The only solution for both problems lies in a more general appreciation of the advances in scientific medicine. To the hospital will fall in large part the duty of initiating and supporting this educational movement.

Exploitation of the patient by the charlatan and the faith healer is a problem that cannot be solved by legislation, for legal restriction can go no faster than public education, and in the present state of public education any attack by physicians is misunderstood and attributed to jealousy and factional discord.

In the face of the public criticism as to the charges made by hospitals these institutions should give intensive study to the possibility of at least a partial reduction in fees and justify by education the part remaining. Among the means of lowering charges to patients are the construction of moderate priced buildings so arranged as to permit simplified service, particularly nursing, the freeing of the private patient from the overcharge incidental to the care of free patients, the building of hospitals only after an analysis of community needs, and the co-operative use among hospitals of such departments as radiology, pathology, social service, etc.

Even when all these steps have been taken, the demands for scientific and efficient service will still require a charge greater than the ill-informed public expect, and hence along with this intensive study of economics must go education. To this end the hospital must keep in closer contact with the public. Hospitals must cease to be an expression only of institutions to which persons go when sick but should become centers for the prevention as well as the cure of disease. They must co-operate actively with all community health movements, and in them should be established the executive offices of the various public health agencies.

Public lectures by well informed laymen and physicians who are drafted for the purpose should be sponsored by hospitals. Public exhibits demonstrating the sources of contagious diseases and how to combat them, the treatment of emergencies, and

similar subjects should also be a part of the curriculum of education.

Nathaniel D. Anderson, M.D., President of the Hospital, more than the institution and report of the clinical of the yearly health examination. Such clinics should be supported by the presence of a high level of hospital nursing, the facilities. The clinical should be organized for the management of the emergency department of the World War, with the physical sciences and the medical and surgical specialties. Scores could be obtained in a single evening and yet a sufficient examination made.

THE PRESENT PROGRAM OF THE AMERICAN COLLEGE OF SURGEONS

Franklin H. Martin, M.D., Chicago. In presenting the first annual report of the Hospital, which had been approved by the American College of Surgeons. Dr. Martin stated that there was a responsibility which he considered of greater importance than this year's report to the Hospital Conference.

It is the duty of the emergency committee for the hospital to take the necessary steps to make a very detailed study of the community which may require hospital care and to equip the hospital to meet the emergency needs of the community. The committee should be organized to take the necessary steps to make a very detailed study of the community which may require hospital care and to equip the hospital to meet the emergency needs of the community.

The American College of Surgeons has accepted the leadership of the three important fields—public health, the physical and the mental. The task of the emergency committee is to take the necessary steps to make a very detailed study of the community which may require hospital care and to equip the hospital to meet the emergency needs of the community.

The 1931 report of the hospital states that the number of patients treated during the year was 39,000, of which 39,000 were treated in the hospital. The hospital is fully equipped to handle the emergency needs of the community. The hospital is fully equipped to handle the emergency needs of the community.

On October 1, 1931, the hospital was opened. The hospital is fully equipped to handle the emergency needs of the community. The hospital is fully equipped to handle the emergency needs of the community.

ANALYSIS OF FINDINGS FROM THE 1931 HOSPITAL STANDARDIZATION SURVEY

Malcolm T. MacEachern, M.D., Chicago. The Hospital Standardization Survey has been steadily increasing in number of hospitals surveyed. The 1931 survey included 340 hospitals. A series of lantern slides presented the findings of the survey. The most important findings of the survey were: (1) The hospital is fully equipped to handle the emergency needs of the community. (2) The hospital is fully equipped to handle the emergency needs of the community.

The table of the medical organization has been observed throughout the hospital. The hospital is fully equipped to handle the emergency needs of the community. The hospital is fully equipped to handle the emergency needs of the community.

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THE PROGRAM OF THE AMERICAN COLLEGE OF SURGEONS FOR THE CARE OF THE ILL AND INJURED IN INDUSTRY

Frederic A. Besley, M.D., Washington. The program of the American College of Surgeons for the care of the ill and injured in industry is a very important one. The program is designed to provide the best possible care for the ill and injured in industry.

ducted by the American College of Surgeons showed that to date the medical service in 84 industries has been approved

The minimum standard for industrial medicine and traumatic surgery was revised during the past year so as to include all the requirements essential for the adequate care of the sick and injured in industry. As one of the requirements the College requests that industries utilize only approved hospitals for the care of their ill or injured employees and that the physicians who care for them be scientifically trained and thoroughly experienced.

The College recommends that all traumatic cases in a given hospital be assigned to staff members specially trained in this branch of surgery and that each case be assured the advantage of consultation with and control by the surgeon or surgeons appointed to supervise this work. The plan raises an economic question, but it is believed that this is not insurmountable. It may be possible to secure these consultations without remuneration to the surgical consultant and thus in no way interfere with the fee of the attending doctor.

The Board on Industrial Medicine and Traumatic Surgery is taking cognizance of the rising ratio of cost per patient involved in rendering better service and of the increasing number of automobile accident patients who fail to pay any fee to hospital or doctor, and is seeking to remedy these economic problems. The board welcomes any suggestions that may be made by hospital directors that will aid in bettering the present deplorable conditions. The angles of approach may possibly be through the correction of laws relative to insurance on automobiles or the bonding of drivers who are not financially responsible.

ORGANIZING A SERVICE FOR THE DIAGNOSIS AND TREATMENT OF CANCER IN AN APPROVED HOSPITAL

BOWMAN C. CROWELL, M.D., Chicago. To date cancer clinics in 68 general hospitals have been approved by the American College of Surgeons. The survey of clinics for the diagnosis and treatment of cancer is still under way and announcement of the others meeting requirements will be made in the near future.

During the current year a minimum standard for cancer clinics was devised by the Committee on the Treatment of Malignant Diseases, of the American College of Surgeons. The merits of cancer institutes and cancer laboratories are fully acknowledged, but it is felt that there is an urgent need for making present knowledge more effective and that this need can be met most efficiently through the formation of cancer clinics in approved general hospitals. Such hospitals, since they are already functioning, form the natural centers in which modern diagnostic and therapeutic procedures can be conducted. Ordinarily these hospitals have the personnel and equipment for such service but a definite organization is necessary in order to obtain the maximum efficiency in the campaign against cancer. Though the mini-

mum standard applies especially to hospitals, other institutions that are shown to have the required personnel, organization, and equipment for carrying on the work may be included in the list of cancer clinics approved by the College.

The minimum standard for cancer clinics requires (1) that there shall be a definite organization of the service to include an executive officer and representatives of all departments which are concerned in the diagnosis and treatment of cancer and that the services of a secretary and a social worker shall be available, (2) that there shall be regular conferences at which the diagnosis and treatment of the individual cases are discussed by all members of the clinic concerned with the case, (3) that reference to the cancer clinic of all patients in whom the diagnosis or treatment of cancer is to be considered shall be either voluntary or obligatory in accordance with the vote of the medical staff or of the hospital's governing board, (4) that in addition to the diagnostic and therapeutic surgical equipment required in every approved hospital there shall be available an apparatus for X-ray therapy of an effectiveness generally agreed upon as adequate and an amount of radium sufficient to insure effective treatment, (5) that besides the records required in an approved general hospital there shall be additional records of (a) the details of the history and of the examination for cancer in different regions of the body, such as indicated in the forms recommended by the Committee on the Treatment of Malignant Diseases, (b) the details of the treatment by radium or X-ray as indicated on the forms recommended by the same committee, and (c) periodic examinations at intervals for a period of at least 5 years following treatment, and (6) the treatment of cancer patients shall be entrusted to the members of the staff of the cancer clinic except in cases in which adequate treatment in accordance with the collective recommendation of the staff of the cancer clinic can be procured otherwise.

The essential feature of a cancer clinic is the group method of study of cancer cases. This is accomplished by a conference of the staff. Such a meeting may be held daily or at longer intervals. The American College of Surgeons seeks to co-operate with cancer clinics by furnishing information as to methods of organizing such clinics, by putting its stamp of approval on those conforming to the standards, by supplying samples of uniform record blanks, by compiling and publishing the results of statistics furnished by cancer clinics, by publishing in the *Bulletin* of the College articles dealing with the work of cancer clinics, and by giving the staffs of the latter an opportunity to discuss administrative problems in a series of round table conferences.

RESPONSIBILITY OF THE FELLOWS OF THE COLLEGE IN PROMOTING THE HOSPITAL STANDARDIZATION PROGRAM

SOUTHGATE LEIGH, M.D., Norfolk, Virginia. The founding of the American College of Surgeons undoubtedly revolutionized surgery in the United

State and all h n r s d t th ganiz to s f u d

The m of the College as a d to put t st mp f ppr l ne eys fe u geon of hgh h ract r and g d st dng Natu lly i n g nizat o s ch s th om i d d al may h be d mitted n the pat ho ver below st da d a number m y hav been excludet wh sh uld be l l w s T av d th s m st ke ch member l a h c mm it e must b f lly l y et h s r spon h l y The pres t method f m m ttee select on a de m nation sho ld assure a h gh gr de m mber h p

Th ugh n every m d cal oc ty each memb r should h s p r t yet the work su ally ca n d n by a few and the o ga izat o nev r thees does t offer The America C llege of S ge s differ n this re p ct in th teach m mb r has a d st net duty to p r f rm and respo s b l ty to bea If he s ot w lling to do his p r t he sh uld res ga

Th f st duty a Fellow o eat the College so to condu t h m s e a su geon as to r f t c r d t n the o ganizat n His next d ty t b e d a d t the vounge s rge n o d e that they may m et the Coll ge tand rd With ut pr jud ce f r o g nst he should pp e disapp ov l the applic nts for f l l w s p a d a d e t h e h t b l w sta dard how to meet the eq m t

The u ge n d t s in co n t i n with ho p t l a em n fold Wh l h m y n th e f l l a thorty y the can at all t me u e h s nfluence fo l l th t s best in hosp tal condu t S geal cl nl e so in stance w l l n v be b t n d w l h uety unless th r m ch str c t r on t r l f the ope at i g o m by s t b l memb r f the su g cal st f l l g e l h s p l there sh uld l w s be at l st t w op at n g room n f cl an c a s and o e f sep t c a s n l s o f r s p o s ble n p tice sh ld be t r d in th m e s r v d fo cl an e s Ope t n g m nd wards mu t b k p t lea and all s p c m t l p r n p tly d t o yed

In ste e p n f l l h s t r and m p l t e p t of ex m n t o of all s a g t f g u a d n general h p t al Fellow m s t e t n t l y t h t th e cords are pr p r l v k p t but must l o n c r n th m elves th st f m e t g nd m y ther detail of hosp t l p ed es

In p n t f h s p t l th e p b l ty f f l l o s i g e a t s. They m t to t h t u l e g v g th p v l g e to p a t i u g r y m a d a d e f r c d. The s c e a g t n d e y f g e a l p c t t i o n s t p e f m g y s i n t U t a d m n must not be allowed t m e d d l w h u m l l U d b t e d y a s t e l f t h r a d m t l t f r m o p p i c t s d t t r a d p e t r N m n should be p r m t t d t p t f r p p e n d t u n l s h e k u l l f u l e g h to o p w t h a c a l g l p e n t n t s l f a t l e s t h n a t o s q u l n d to h n d l y d t w h c h m y h should o t b p e m t t e t i n t h b d m e a t l l

I l e u o f f g l t o n r t t c t g u g r y t p s o n s f s p e c i a l q u l i f i c a t n w h h w l l e q u t m b e

f r e t s p t n t o e f f e t F l l s f t h C l l e g e s h o u l d c e t t t h t i n the h p t a l s w t h w h c h t h e i a a t d u t a n d a d u q a l i f i e d m s h l l n t b p e r m t t d t p r t

T b e c e a s a f e s u r g e n t i s i m p t n t t h a t t h e d d l b e p o p e l p e p d n t h e o r y b t n a d d t n t i a b s l t l n e s s a r y f h m t o k d b y s d e w t h n e p r e n t d u g e o n f o r s o m e f g t h l t m e A p p e n t e c h p s t l y e s s e t a l n d u n t i l t h s p s t e f a c t s e c o n d g e r a l l b y t h p r o f s o t h t s k f t h C o l l e d l l b d f m c l t o B t t h e m e m b s m t a t f l t r f h u m a n l i e s t s t k e

THE UNIFICATION OF AIMS IN THE HOSPITAL

REV AL HONSE M SCHWITALLA S J PH D St Lo The p a k e r m p r d t h h o p t a l w t h the h u m n g n s m r e s p e c t t h e p n c i p l e s f o r g a i z a t o D e l p n g the a n a l g y he p o i n t e d u t t h a t t h e o r g a m o s i n g l e o r g a n i s l l e d u m e a u e d f e d o m n t d e l p m e n t T h e h a r t the k d n c y the n r v u s s y t e m n y o e o f t h f l l s t p l c d u r n t h m l p o c e s s o f the d v d u a l s d e v e l o p m e t l k e e t h b e t h p t a l n t t h t w h c h e c h a d e p r i m e t s i n v i g i t a s b e s t p a b l e d e l p m e t b u t s t h t n w h b t h e p r t a r e d e l p d i n e l a t t t h e c p r t y the r e s e a d t h r v c e of the w h o l e i n t i o n

This f i c t i n f i d m n t r i e a m s of the h o s p t a l n b b o u g h t a b o t n l y b n n e g r a t i v e p c s A t e g a t i m e t h a m r e s m m t n j s t s t h r g m m o r t h n e t p l k i d n y p l u s r v s y s t e m a n d r t h e r a n u e d e l t y i w h c h m o s t m p l i c a t e d e l t s h p s s o m f t h e y g t t h e r a t g t e s d m e n t r a l h v b e f l t d m n g the v a r i o u s o r g n s T h p r e s i g r t h d d i r e c t i o n a r c a u s e t a l h a n g e i n the g n s m l a the m e m e p r t f t h h o s p t a l a v t g r w t h u t f l e t g the p r s a d t h s g v a l g t h n t u n s e l t d p o n t h e a t t i g d p a r t m e n t m p t g t the l a t t a e w g v t h t c e m o r e t p o t h r m i g d p a r t t h e s t r p l a y s e n f r e m p l w h n a n e w r e c o r d l b r n p s e d f i b d v i s n d e g v t c a d t h d p t m t t h t h e s c o m p l t r l i f t h e t r e h p t a l w h e a d d l f h l f i n r n g t h c r p l e t r h b l t t l a n s i t u t i o n

T h p l e f i g t g t n s l d m t f t h t h h p t a l r l h w e v e A t d y f s c h r l e s e e l s e c l l t o e d w n p i f t h e t t u t i o n a s w h l n d l f r t h s d p t m n t s b t f i g u l t a p p l y g t t h r i t f o e d p a t n t t h t h t h e r t h n s a r y t g a t f t h r t h l g v d p t m t f n t e t h t h h i h o p t a l u h l d b e w r t t f r the a d m i s s i o n g n n g t h d p t m e n t l p t h i g y f t h e w h o m u s t f q d i f m t h p t i l a d j n e t c h a r g a n d m u t p l the p u p s f i b o t r y o l w R g l t n e g t h p a t h l o g l l b o t r y w t

also appear in the floor supervisor's rules, in those of the surgical department, the medical staff, the X-ray department, the outpatient division, the social service department, and the record room

OUR CHALLENGE—HOW SHALL WE MEET IT?

PAUL H FESLER, Minneapolis The responsibility of conditions existing in hospitals, medical schools, nursing, and public health rests primarily upon those responsible for the administration of the national medical organizations

The first challenge to the medical world was the Flexner report on medical education, the results of which are history. As a result of commercialism in the medical schools has been done away with, the graduates practice modern medicine, and the death rate has been reduced. Medical laws in most states have been revised to meet the standards of medical schools, and in a few states basic science laws have been adopted. The success of this program depends entirely upon the unbiased, fearless attitude of the Council on Medical Education of the American Medical Association.

The second challenge to medicine was the standardization program of the American College of Surgeons. These standards have controlled medical practice in hospitals. The movement has been most successful in large hospitals, but it is significant that small institutions have not improved as they should. If this challenge is to be fully met, the medical organizations must foster legislation to enforce these fundamental standards in small hospitals. The Fellows of the College are in a position to influence such legislation in their local communities and also to aid their local hospital superintendents in meeting the conditions of standardization.

Improvement in medical education and in hospital facilities has been a factor in increasing the cost of medical care. The result has been the formation of the committee on the costs of medical care, the studies of which when completed will challenge the medical organizations to face the facts presented and to form unbiased conclusions from them.

The report of the committee on the grading of nursing schools, which shows that there is a great oversupply of nurses and that the earnings of nurses are low but that the cost of nursing is too high for the patient, offers another challenge. It appears that there should be two types of nurses: one group for the usual service and another for the specialties and for teachers and executives. The first group would be trained in the average hospital and the second in teaching hospitals. This is a challenge that must be met by those responsible for medical practice.

Finally, the Children's Charter of the White House Conference on Child Health is a challenge to the medical groups to organize prenatal clinics, mental hygiene projects, clinics for periodic health examinations, and to develop a complete program for child health and welfare.

Each of the national organizations representing organized medicine should create committees to

study from the standpoint of its own members the reports and conferences of the type mentioned above. Similar committees should be created in the states and in local communities, all for the purpose of promoting co operation among the national groups, eliminating duplication of their functions, and maintaining the fundamental ideals of medicine. If there is found to be duplication of effort then a joint group should agree on a program which will be of the greatest value to the public.

THE SIGNIFICANCE OF THE SEEMINGLY INSIGNIFICANT MATTERS IN HOSPITAL MANAGEMENT

DONALD GUTHRIE, M D, Sayre, Pennsylvania As a rule the patient has full confidence in the hospital's medical service, but strict attention to minor details is important if he is to be satisfied and made a loyal supporter of the institution. To give these minor matters the attention they deserve requires the constant and friendly understanding of the superintendent, the directress of nurses, and the medical staff. Too often those in positions of authority are more concerned with what, to them, are weighty matters. The superintendent spends much of his or her time devising economies to be reported to the board of trustees. The directress of nurses gives most of her attention to the prescribed curriculum of study which, by the way, has made necessary the overstaffing of hospitals with nurses and is fundamentally the cause of much of present unemployment among the nursing profession. The medical staff is more concerned with the intriguing morbid pathology of the patient than with his mental reactions.

It is the spirit of the hospital that the patient remembers long after his illness is forgotten. This spirit is manifested at the very entrance. The doorman, for instance, is an important member of the hospital group and he should be an astute student of human nature. Admission clerks also should be chosen for their ability to deal tactfully with worried and confused patients. While waiting to be taken to the ward or his room, the patient should be spared unpleasant sights and sounds. The patient should be made to feel that his interests are being looked after carefully and that he is not being neglected in any way.

The problem of telephone service is important, and not only should the operator be alert and well-trained but she should be supplied with correct information from the medical staff about patients who are critically ill. This information should be sent to her after early morning rounds.

New patients should not be placed beside those in an extreme state of illness. The hospital should be equipped with recovery rooms, small wards, and isolation corridors for the postoperative, the very ill, and the delirious patients. Patients who have been operated upon should not be moved into the ward until they are free from pain, and no painful dressings should be done in the ward, nor should a death be allowed to occur in the ward.

ment funds are in the 14 states east of the Mississippi River and north of the Ohio River. The idea of endowments does not seem to be popular or perhaps to be understood in the southeast, southwest, and northwest portions of the United States, possibly because of the sparsity of population and because of the large number of doctor owned hospitals in these localities.

Eighty-four per cent of the hospitals stated that they maintained out-patient departments but only eight institutions stated that they had a connection with a hospital for convalescents. Most hospitals reported that their facilities were used by physicians in the examination of patients in their private practice, but few stated that extensive use was being made of such services. The trend, however, is definitely toward the physician having his office at the hospital. The questionnaires showed that few hospitals made surveys to determine whether or not they were meeting community needs.

Discussion

C. W. MÜNGER, M.D., Valhalla, New York. Hospitals deriving support from private funds may experience major difficulties in balancing their budgets, due to the added free service and the decline in income from paying patients. It seems quite proper that public tax funds should assist private, non-profit community hospitals in accordance with their needs and the public service they render.

At recent hospital meetings the question of reduction of salaries has been discussed and the general conclusion has been against cuts which would reduce efficiency. A program of economy should not be extended to the point where essential standards in the proper care of the sick must be sacrificed.

THE STAFF CONFERENCE ASSURING A THOROUGH REVIEW OF THE CLINICAL WORK

ALTON OCHSNER, M.D., New Orleans. Too frequently hospital medical staffs comply with the letter of the requirements of hospital standardization that pertain to clinical conferences but do not enter into the intended spirit. A staff conference in order to be successful must be well organized. The program should be prepared at least one month in advance of each meeting by a committee of enthusiastic staff members. If feasible, the various departments should be represented on the program committee.

Another essential is the choice of a suitable chairman. The presiding officer must have the respect of the entire staff and should, as a rule, be one of the senior members. He should also have considerable clinical experience in order to be able to evaluate the facts presented concerning individual cases, especially fatalities. He must possess a great amount of tact and should be able to rise above petty jealousies, especially during a consideration of the fatal cases. The superintendent, because of his administrative ability, if he satisfies these requirements, would make an ideal chairman for staff meetings.

A regular and full attendance at staff meetings is not only desirable but also essential. This may be accomplished by having the programs so interesting and instructive that members will not want to miss a meeting, by instilling a sense of loyalty so that the staff will attend because they feel it their duty, or by imposing some form of penalty for absence. Unless the conferences are made attractive enough so that staff members will attend voluntarily, little interest will be taken in them. Posting attendance records in a conspicuous place is of some help in increasing attendance but should not have to be done except as a last resort.

Analysis of the fatal cases is one of the most important phases of clinical conferences but far too frequently is only perfunctory. Each death should be considered separately and a free discussion conducted in an impartial, scientific manner. There should be complete information on every case, particularly that obtained by postmortem examination.

The following methods of conducting discussions are used successfully today: (1) A week before the meeting abstracts of the cases are given to two members of the staff, neither of whom has seen the case and whose only interest in it is scientific. These two persons open the discussion and this is followed by general comment, without any reference to the attending physician. Laboratory findings are presented, including the report on the pathology, which is given by the pathologist himself. The discussion is closed by the chairman, who reads a summary of the case, including the final diagnosis and treatment. (2) The facts concerning the cases are presented by the physician in charge, without any mention of the ultimate findings, the final diagnosis, or the treatment, and then general discussion takes place. With this method the staff are more apt to discuss the case impartially because, being unaware of the ultimate findings, they cannot be accused of destructive criticism. After general comments by staff members the remaining details, including operative and necropsy findings, are presented by the attending physician. (3) The clinical findings, all important laboratory data, and the report on the pathology are presented by the chairman, who also opens the discussion. The chairman, in such an instance, must be an exceptional individual, since he must not only have had extensive clinical experience but must also be fair in his judgment. His comments are followed by general discussion. (4) The clinical findings, which should include laboratory data and the necropsy findings, are presented by the pathologist who, in an impartial way, states the facts. This information is then discussed very frankly by the staff with the sole purpose that everyone may profit by the case.

The report of critical studies of the clinical results obtained in the hospital is also a desirable feature of staff conferences. Without such searching analysis of end-results, there can be little reliable knowledge concerning the efficacy of the various forms of therapy. Material of this nature is also of educational value to individual members of the staff.

demonstrations, to which each chief of service devotes a certain amount of time, should be arranged as part of a conscientious effort to instruct the internes. Every interne should also be given problems of research, probably not more than one a year.

Hospitals near teaching institutions are in a position to arrange for frequent evening lectures participated in by members of the faculties of neighboring universities programs which are profitable for the entire hospital organization.

During such an internship in which work in the wards, operating rooms and laboratories is supplemented by seminars, conferences, demonstrations, and research, the young graduate acquires a fairly comprehensive knowledge of general medicine and develops a sense for scientific work. Men going into specialties and internes who are outstanding in their abilities should be encouraged to continue their studies.

An urge to undertake surgery is being too frequently experienced by recent graduates. As a result too many young doctors are advising unnecessary operations and are attempting surgical work they are quite unable to perform successfully. Present educational requirements with their severe demands in time and money, the necessity for the graduate to support not only himself but possibly also a family when he has completed his internship, and the present economic stress are all factors tending to the adoption of short-cut methods in the period of preparation between graduation and entering upon practice. Many of these young doctors undertaking surgery without proper training never become fully aware of their incompetency.

Before an aviator may make a solo flight he must demonstrate to a federal officer that he is thoroughly competent to take his life in his own hands, but any doctor who possesses a state license, which is no evidence of surgical ability, can without any restriction take into his hands all the other lives he may wish. That some further restrictions than now exist are necessary cannot be doubted. The American College of Surgeons has before it a problem the solution of which it is in a position to accomplish more than any other agency in this country. If it can succeed in correcting this outstanding evil it will make even a greater contribution to American surgery than it has in its splendid work of hospital standardization. In any event it will be in the hospital and with the resident staff that the chief effort will have to be made.

Discussion

T DWIGHT SLOAN, M.D., New York. What the interne most desires is to be closely associated with men of outstanding professional ability in order that he may learn from them how best to examine, diagnose, and treat patients. It is this direct and expert guidance of senior men of high reputation that constitutes the chief attraction of an internship. Given this, the interne and the resident will gladly avail themselves of all the extra aids to training, such as

conferences, clinics, and research problems. It is obvious, therefore, that there is a great responsibility resting on those who direct the systematic training of the internes and residents and also that there is a corresponding opportunity for the attending physicians to multiply their usefulness through the influence they exert upon the younger men.

ADMINISTRATIVE AND ECONOMIC PROBLEMS ASSOCIATED WITH THE "OPEN" HOSPITAL

FRANK J. WALTER, Denver. It is with the larger number of doctors having the small number of patients in the open hospital that the greatest problems arise. This group manifests less loyalty to the hospital and less deference for its rules, the economy of supplies, the program of education and research, and the standing of the hospital in the community than is usually shown by members of a staff in a closed hospital.

Studies show that most of the general hospitals have staffs which might be termed open, but from another point of view might be considered closed. Their organization consists of a more or less select group of physicians who hold regular staff membership, and in addition a large number of doctors classified as associate or courtesy members, and sometimes also a consulting staff. This means that the actual voting staff is the closed part. The open staff, in the sense of admitting doctors indiscriminately, seems to be a thing of the past in all standardized hospitals. The open hospitals must have some regulations which will enable them to bar physicians not in good standing without making the institutions liable to lawsuits for damages on the part of barred doctors.

A well regulated open hospital better serves the community and the patients as a whole, while the closed one perhaps better serves an individual group of doctors and their respective patients. In a large community there is a place for both the open and the closed hospital, but in the small community it is almost imperative that there be at least one open or semi closed hospital. The policy of allowing every ethical physician hospital privileges might seem too liberal, but the contact of mediocre doctors with the hospital's resources and the more skilled physicians may lead the former to improve the quality of their work.

Another problem of the open hospital lies in the fact that staff conferences are frequently less well attended than those of the closed institution. Due to the physicians' lack of responsibility to the open hospital it is harder for the latter to secure co-operation in obtaining autopsies, and because of the few and irregular visits made by some physicians, it is more difficult in the open hospital to train the courtesy staff in the making of complete clinical records.

Because the patient-day census fluctuates more in the open hospital and it is therefore difficult to utilize the personnel most efficiently, the open hospital's cost per patient day is greater than that of the closed hospital. The closed hospital usually leads to

in number for the year 1930. It is also found that arrangements are more frequently asked for future payment.

As one of the means of partially compensating for such losses the pay of more hospital employees might be adjusted to include their maintenance. Employees would thus be receiving substantially the same amount as previously and the hospital would save through quantity buying and utilization of the same kitchen personnel in preparing the larger number of meals that would be required.

Few hospitals will be able to effect extensive economies in heat and power, although in some areas it will be possible to use a cheap waste fuel. Study of the handling of hospital linen shows that the use of the outside commercial laundry may add a considerable financial burden because of losses in articles and failure to make repairs promptly. In some hospitals, the saving from having the laundry done in the institution amounts to $1\frac{1}{2}$ to 2 per cent of the gross earnings. The hospital's department of salvage and manufacture may also effect economies, particularly by reclaiming old linen and making up new articles.

A factor of real importance in the economical running of the hospital is the substantial decrease in the cost of certain hospital commodities, particularly food, which shows a decrease of about 20 per cent in 1931 over 1929.

A reduction in the charge for private rooms is not advisable as there is real economy in having them empty rather than filling them at reduced rates. Should conditions improve and the rates be raised on private rooms once lowered in price there would be resentment on the part of patients readmitted, who had previously paid the lower rate.

In some instances, the closing of nurse training schools might make for economy, but it is quite likely that no changes will be made for the sake of any economies that might result.

Decrease in the collection personnel is false economy. Moreover, the hospital should maintain its own collection department as no commercial agency can understand the hospital's collection problems as well as persons on its staff. Reduction in the pay of hospital employees should be instituted as a last resort, when all other expedients promoting economy have been exhausted. Substantial as may be the saving effected in this way, it proves small in proportion to hospital costs as a whole.

FACTORS TO BE CONSIDERED IN THE COST OF MEDICAL CARE FROM THE STANDPOINT OF THE HOSPITAL

WILLIAM H. WALSH, M.D., Chicago. All the reliable data concerning the costs of illness point to the following fundamental facts: that the largest share of the total outlay for a given number of families falls upon a small proportion of the total, that sickness insurance has not yet been worked out on a practical basis, that the average expenditure per person decreases with the size of the family and hence in-

dicates that those of larger families either do not receive adequate medical care or use clinic services, that the average family and the average individual cannot afford to pay the prices now charged for adequate medical and hospital care, that neither the average physician nor the average nurse appears to earn an excessive income, and that an appreciable amount of the charge made for hospital care is not properly chargeable to the care of the sick, such charges, for example, as the cost of nursing and medical education.

Several factors contribute to the cost of hospitalization. One of these is that there are too many separate hospitals in too many communities, thereby increasing tremendously the overhead. The complete elimination of some hospitals and the consolidation of others would increase efficiency.

No hospital can render adequate service and make a profit at a price within the means of the patient of moderate income. Other causes of high costs are waste of space, ostentatious display, poor designing, and defective engineering in hospital plants, also the fact that there is much expensive equipment purchased and not used.

As a measure to reduce hospital charges to persons of moderate means, accommodations should be provided to suit the patient's economic status. The practice of overcharging the pay patient, without his knowledge or consent, is indefensible. The hospital world should formulate a policy to the effect that the rate to private or semi-private patients would be based on the cost of accommodations and service used plus a reasonable charge to cover bad debts and obsolescence, that the rate for part-pay patients would be based on the cost of accommodations and service, less an amount to meet the patients' ability to pay, the difference to be made up from endowments or taxes and under no conditions by overcharging other patients, and that the cost of full charity patients would be met also by contributions or taxes. Workmen's compensation cases cannot be considered as charity cases and should be a charge against the industry concerned.

Nurse training is not a just charge against the sick and should be borne by the community in the same manner as other educational projects. Group nursing has proved successful when properly regulated both from the standpoint of adequate and economical care of patients and that of the income of the nurses.

Inefficiency on the part of hospital superintendents is often responsible for high costs of hospital service. There is a crying need for a standard qualification rating for superintendents, and there should be some national agency to pass upon and approve those who are qualified.

Co-operative buying among hospitals, more institutions for the care of chronics and convalescents so that patients not acutely ill will not have to pay the necessarily higher cost for beds in hospitals for acute illness, avoidance of unnecessary hospitalization, and greater efforts at leadership on the part of eminent

vidual, for in so doing he will stimulate that person to do his best. It is sometimes found helpful to make special mention in conferences of those who have done exceptionally well in any work. When the superintendent has been liberal with his commendations it is then not so difficult to point out faults, and criticisms will therefore be received in a good spirit.

The director should study the individuality of each staff member and make it his pleasure to see that every physician is as nearly satisfied as possible without relaxing the rules of the institution. Instead of making rules and then trying to enforce them, the superintendent should induce the staff members to make the rules and call upon him to see that they are observed.

Patients are usually the first to sense a lack of harmony and efficiency in the hospital. Even before the administrator finds that there is a flaw, the patient will have discovered it by conversations with nurses and others or simply from the atmosphere of dissatisfaction. A superintendent will do well to come in contact with his patients frequently and to catch their reactions.

If the superintendent has harmony and efficiency among his hospital family, he already has two mighty forces to aid in securing community good will. But in addition to satisfied patients he will want such other means of eliciting good will as newspaper publicity, magazine articles, a hospital paper, radio address, and community health meetings. Five free health forums were sponsored by the Baptist Hospital, Houston, during the year, and the consensus was that they were one of the most successful means of benefiting scientific medicine and the hospitals.

When the public has been informed of the activities and services of the hospital, it is not difficult to inspire them to befriend the institution, and the very act of giving will increase their good will.

THE GENERAL ORGANIZATION AND SCOPE OF SOCIAL WORK IN MEDICAL INSTITUTIONS

M. ANTOINETTE CANNON, New York. The scope and function of medical work center in an attempt to understand and deal with the social component in disease. The idea that there is a social element in disease is a concept relatively little used.

A social component in a health problem does not necessarily mean a social cause of a specific illness. The subject of cause has proved too difficult to allow any clear conclusions except perhaps in the field of psychiatry and of public health. It is evident, however, that social situations and personal qualities condition response to treatment and therefore social study has been found of use in connection with prescription and prognosis. In the carrying out of medical directions and the organization of the social situation, the social worker's relationship with the patient as a person may play a part in getting a result. When the social element enters in, knowledge of anatomy and physiology is not enough for prognosis.

The following principles might be used as a guide as to the scope of the medical social worker:

- 1 The medical social worker should be able to make a thorough social study and to carry social treatment to a conclusion.

- 2 In general it is better that the agency prescribing should provide for carrying out the treatment. This means medical social relief and medical social case treatment.

- 3 To the special agency should be referred the appropriate special problem for diagnosis and necessary treatment, not for the carrying out of orders.

- 4 When two or more agencies are working together on a case the decisions and plans should be made jointly and the part of each agency should be understood by both.

Concerning the question of whether the hospitals should endeavor to do something for every patient or try to do the best for the few who chance to come to them, it would seem that both the quantitative and the qualitative standard should be upheld. There should be a routine social inquiry as a basis for choosing cases for social study and treatment. If the doctor, rather than the social worker, is to make the social history, along with the medical, he ought to be better prepared than are most physicians at the present time.

The undesirable practice of having hospital social service departments administered from outside the institution is tending to disappear. The practical difficulty in relating social work adequately to medicine is that the social service staff is relatively small and thus must serve two or more masters. The best form of organization seems to be to have social workers adequate in number to cover the needs and to assign them according to the division of medical service.

The hospital is the strategic place where medical social processes may be used in the interests of the patient and where they may be combined in a study of the interrelation of medical and social conditions for the ultimate promotion of good health, good social behavior, and a good social order.

MEDICAL SOCIAL WORK IN INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

LOUISE C. OBERCRANTZ, New York. An indication that a considerable number of persons find it difficult to return to former employment once they have sustained a physical defect is the fact that in the first 3 years of the existence of the New York Employment Center for the Handicapped, some 9,500 applicants registered. Employers co-operated to the extent that 5,800 placements could be made. The need for careful study of the applicant is shown by the fact that of the total number seeking work, 13 per cent were found not only to be unsuited for placement in industry, but were in further need of medical attention, institutional care, or were hopelessly handicapped.

The difficulties which both physicians and social workers often encounter in compensation cases, in spite of the most expert medical work, are often traceable to a disregard of the patient as a whole to

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DISCUSS

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p a s t r t a c l r p t Th b d d e l p
m t f s o l s e c e h w i s p f d l v f
f e t d y the deg t h h t h w b l m n
p o l c y p r e u l s m e d i l t t t n

I l s p t l s r e p e d g m y t h s a d f d l l
t o p r d m a g o f d a s e d j r y h t t
n g u t h p t l l y b b l t t d w h f i d t h r s
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l t c o t r b t e l l s h e c b y h e d e t l e d s t d
f t h e p a t e t I f p b l t h p h y s c n s h l d g e
t h s c i a l o k e c o r r e c t m t f t h h a d
c a p p e d p o n s a b l i t y t e g g e i s o m e l f
w k

SOCIAL SERVICE AND CANCER CONTROL

GEO GE H BIGELOW M D B s t n C r c o
t l w t h p e s t k w l e d g e d e p d p n t h m
p l e p l e s the c m l f a l l p o h l s o u c f
h n e t a t i n a r l y r e c g t n of the d s e
d p o m p t d m n t i o n of d e q s t e t h e p y

The soc l o r k e f r m e d m m b e f t h
p h l c h u l d p a h e r k w l d g e of the e t l o g
c a l f a c t o t h e d s I t h f i l d o f l y c o g
t n s h m u s t b e f m l a r w t h l l p u b l i a d p
v t e s o f r r v c e t h e d g s f e c e
a n d h e m s t k w f t h s m p l e l s i g n s s f f
e n t l y d a l y t t m t m t a t g l y to h e r c h
e s T h g a l p b l t s h l d b e x p e c t e d t
h a v e a t e l l i n g t k n o w l d g e of the s m p l e h
d g r s g n s of l l m p o r t t d i s e s T h i s k n o l
e d g e m e s u p p o l l t b e e d h t n a f
t h e l t t b d a i n f l l y n f t e t

I f f o s p t l d m a s f e a c h a v c a e d j
p e e n t n M s c h u s e t t e p s t g y e r
p r o b l y d u e to t h c r e g c a c e r s e s s
m o g p h y c i a n s m a c t r e p s i b l i t y t h
p t of s t a t h s p t l m m k g t h r e e
e d l y v i b l f r s e c e t a r p t e t a d
g e t w a l l f t h p b l t m k e f t h e s e
r s o

W h e a d g o f c a c h a s b e m d t h e
c u a l w k r t t h c a f i l d h t h a d d r
p n s b l i t y f m l g e l r t h e p t j s t h a t
h m u s t d a b o u t t I f c a h n t b e e d g
d t h s o a l w k r m t c o i t h p t t f
t h I e f t h m d c a l p d p r s d e h m
f t h e n e e d f r t n g y l l t h t p r e n t
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m h b g g t h a t h c e p b l m t l f l n t h
a s f p t i s t h d f d d g e s t h e s o c l
w k r m t c o c t h e m f t h e m p o t f
m t s t h m m e d t f t e s o t h t t h y
l l t l s f t h a d t h d l y t a t m t

A l g p t f t h s o c l w k s e p o n s a b l y
m t b t m b l a d c l l t t h e f a d t
d q t c o m m t v s o c d t o s e t t
t h t t h p s o c m t t h t t t f t h s h

can provide treatment To work out a practical plan for treatment is not enough, however The plan must be followed through, and there must also be extramural follow-up As long as 45 per cent of clinic patients show an interval of more than 6 months between their first visit to a doctor and the application of adequate therapy, this phase of follow-up will offer perhaps the greatest opportunity to the social worker in the whole field of cancer control Though not a part of cancer control, it is the duty of the social worker to provide not only relief from suffering in terminal cases but also custodial and nursing care

Discussion

FRANK RECTOR, M D, New York There is no disease in which the social problems connected with it demand a person adequately trained in medical social work more than in cancer The social worker can be of aid in tracing responsible friends or relatives and acquainting them with the facts, in making financial arrangements, in persuading the patient and his family to see the matter through, and in following up the patient over succeeding years The social worker, too, can easily keep in contact with the patient so that he will not fall into the habit of shopping around for medical attention and thus delay needed treatment The insistence necessary at times to obtain accurate information regarding old patients may strain the ethical principles of the physician, but will have no such inhibiting influence on the social worker whose training will enable her to follow such cases through to a conclusion

The function of the social worker as an educator cannot be too strongly emphasized Her contact with the social background of the patients will enable her to ferret out cancer histories and suspicious symptoms that will be of great aid to the attending physician

OUR RESPONSIBILITY AS TRUSTEES

F L BRAMAN, Torrington, Connecticut Trusteeship is a distinction and a trust expressing honorable estimate of a person's standing in his community It is expected that those who accept such positions will evidence the same interest in the hospital as in their private affairs A composite board, one composed of professional and business men, should be better able than any other to cope with the many problems arising in hospitals Members of the active medical staff, however, should not be eligible for appointment

Trustees are not required to follow the routine of the everyday business of the hospital but instead should delegate such duties to the administrative staff It is the responsibility of the trustees to know that those chosen to represent them in the management are honest, capable, and diligent in the interests of the hospital and the public which it serves The superintendent should be selected for his executive ability, thorough understanding of hospital and medical procedure, and some knowledge of law, in

addition to qualifications of character Once he has been selected by the trustees, the latter must respect his judgment The line of authority is always through the superintendent and never directly to his subordinates, as any other method is demoralizing

The courts now obligate trustees to "exercise due and reasonable care" in the selection of the hospital's medical staff The right to select the staff carries with it the right to reject any person who in the opinion of the trustees is undesirable

Regular attendance of the trustees at meetings is essential, as this affords them the best opportunities to secure full information on the affairs of the hospital It is the function of the board to insist that efficient business methods are used in the hospital, that all trust funds are safeguarded and properly administered, and that endowments are increased One of the most important responsibilities of the trustees is co-operation with local health and welfare agencies thus to make of the hospital a community health center

Discussion

WILLIAM C GEER, Ithaca, New York The three billion dollar capital investment of the more than 7,000 hospitals in this country indicates clearly that if these institutions are to be properly operated, the trustees must apply to their management those principles of organization which have made business elsewhere a success The hospital has ceased to be a charity to which a gift of a few jars of jelly is able to satisfy the conscience of the giver or the needs of the institution

In order to place hospital management on a business basis, trustees have a duty to obtain, by reading, attendance at meetings, or by actual efforts in directing their institutions, a concrete knowledge of the problems involved In acquiring such knowledge or executing their responsibilities, however, trustees should never attempt to carry out any policy over the head of the superintendent or other active employees No director of a corporation would think of going over the head of a general manager or superintendent and giving orders directly to a factory foreman No more so should a trustee give his orders to any except the hospital's chief executive

PROMOTING A BETTER UNDERSTANDING AMONG THE BOARD OF TRUSTEES, SUPERINTENDENT, AND MEDICAL STAFF

CHARLES F NEERGAARD, New York No one thing can contribute more to hospital progress and economy than to have a large proportion of the members of each board of trustees grasp the basic principles of hospital service and contribute more of their business experience to hospital management

Four principles to be kept in mind in maintaining proper relationships of the board to the superintendent are (1) the trustees should direct and the superintendent administer the hospital, (2) the trustees should define the fundamental policies and the superintendent see that they are enforced, (3) the

bas cpr ciples of good hosp tal m n em nt should be dent cal w th good bu ness ma gement (4) th t ste sh ld be n post t appraise the qual t f th h p t l s r v e nd the ffe c l t dm tati

S und m nag m t q es that th s p n te d nt meet th th bo d v th s fnd e grded The sup ri tend nt po t bod ma d a ce tralzat o of utho ty y t t use f eq ently cr tize emplo es nd g v order dr f ly po ced wh ch tends to b subv i e f d s c r l e The trustee s h uld g e the sup ern d nt the ba k i g a d d c c nst ntly ne ded as ell a l t d n c c d c w th h capacity The a e n m o i t c e he m n d lgh b lty g en too l t l a th r t d me of sm l l ab lty too m h

In th w o k f tabl h ng pol c i es th trust s sh uld nde de ns on the fll w g th b d m d e l l f i c a t f p t t b e d m t t e d the b f t a f f p p o n t m s d h r c c o t h s t d r d f the Am t ca C l l e f S u g e o s a d l t h Am a Medical As c t n the c p e l t h supe t d e n s d u t e the b d g t the f i a c l p o l v d l g i t h p t n t d n l l c t n g a t p b l c t y c a t o s c m p n s a i t o c k m p l e the u r r u l m f t h e s h l n n g Ma v t r u t e e s t i l l o k s o h h p t a l p r i m i l y a h s p e t c h i t y a t h n g s o m e h a t p t f o m b u e R a l d e a t h b o r d h e c m p e t e n t l s m d e f t h n d r l n g c a s e h a d f i c t e t r

Tru tees t d c a f n d p e d t n a l m t e s b y c t t h r i s e s n o n t i t h h s p t l m n a m t h e c t h f t t h a t t h e a e o t e x p e m e n d n h p t a l p c d e s e e d o t d t h m f m m k i n t h o g h p p r a s a l o t h t t u t o h h t h y e r v e T h f l l n g t h e m e m p o r t n t y d i c k b h h t r u t c a m s r h p u t l i e s

I s t h h p t l t d t t e m m t y n d d e q t l y q u p p e d m l l d p r t m t f t h r a p g r a m t m t l n d m t l d e f i c i c n e t h f n s r e r v e

3 I t h c h m f g i z a t s o d n p c p l

4 I t h m d u a l t f f d q u a t d e t h s t

5 I t h e h p t a l p e d t a t l e a s t 8 o p e c t c a p t l l d u t w h t m d t

b e a p p l d A r t h r m p l m m o d t n s d p e c i a l d e m t f t h m d d l l s s

6 I s t h p h c a l g l t g o o d o d t o

7 I s t h e p p t t r s o n a b l

8 I s t h e h p t l c o d t d g e u e p t f s e r v e e

9 I t h e b m a g m n t s o u d d m d r n?

o I t h e s p e n t e d t t f t r v b u s a s m g e t c o t o w o k d t e d t h

J o b I f l l g v a c i e s f r t h p o t f p e r s t e d e t i f r g h o s p t a l s t l d b e f t a n t g

t c s d e r t h a d m i n i s t a t b o a r e d i n g g o o d w r k f o m l l n d m e d u m s i z d n t t u t n s I l l s p t l o u l d w l l p o n t h e t a t e h o s p t l s o c i a t i n l o r s l o m a t o c n n l l k c a i d e s

C c g t h r e l t n f t h m e d u a l s t f i t t h m a g e m n t i s t a d a b l t h a t m m b e r s f t h c t s t f b a p p o t d t t h e b o r d o f t r u t e e s G o e r g b o a d f p t e h s p t l s h t h g h t i d t e r m i t h r e s o b l a b t r a l y t h q u l f i c i s f t h p h s i a n s h o m v p r a t s t h e h o p t l T h e s h o u l d h e r b e c o m m i t t e e n m m b r f t h c u l t g s t a f f w h o m t h b o d c a r l y f r u p r e j d i c d g u i d n e m a t t e o f t f f p p o t m t s d p l o o l s t d r l

The m d c a l t f f s h o u l d h e g u l a n d d u t f f c a l c o t t w t h t h t r u t e e s I h m o t l g r a l d g e n e r l l y a c c e p t d p e d e f r f f t g t h u s t h r o u g h t h e f o r m a t o n o f a m e d i c l u n c i o t g f t h c h i s f t h e m a j o r f e s s n a l s e r v c s n n a l l y p p o n t d b y t h e b o a d n r m e t r u s t s a d t h s p e t d n t S u c h c n c i l d s o y t b t h m e d i c a l a d l a b o a d I t h a s t h a d t g o f p d g p p t t y f r e m a n c o n t o f n e c u s e f r v l o o k g m p o t a n t n e e d n b a f m s d e r s t a d n g s

T h e r a s e n u m b e r f t e l o c a l h o s p t a l c c i s n m e t r p o l i t a s s i m t c o m m e d a b l f m t h e s t n d p o t f b e t t e r g r e l t s m n g t h t e s e s p e n t n d t d m d c a l t a f f

D e u s

J o i n R H O W A R D J R N e Y r k T h e m t l a l e m m d a t n m d e b y t h p e s p e k e r w a s t h t t h e t u s t h u l d k o o h i s s p e r m i t d n t a s m a a d s e x c t e P b b l y t h m e m p o t t n d t h l s e c m m i t o k w h m s s m A h s p t l d r e c t u p e m e l o s t o a t h s a h i e d m p l v d p d t p o n h s j b O e e e d b u t t g l a e a t t h t t c a l p o i s h w g t h r p d t n v r n h s p t l c t s t k n o w b o w s c u e t h s d e p e n d c e a d t i s t h i s r y d t t h a t l e s a t t h b o t t m f m u c h t e f f e c t e s s h s p t l e c t s

T o f f t i t t h t r u s t h o l d e n u g e t h e p e n t d e n t f r a n k p o f f f r s u t h e h p t l t h e m d c a l t f f e t h e b o r d f t r u t e e s t e l f d i s h u l d g h i s d a a t h s e f p e r s o l t t h e e d s i t h e h p t l O n t h a b s i s t h e t t l d b r i g t t h d m n t r a t s n o t f t w d c o d t n t s m p l y t o h f l k b t a s p t e r i d f f i c u l t a n d o m p l t d h u m r v i c S p t l e t w t h h b c k n g w u l d e p o t d e f i c i e s p e r a t n d t h e w n a b i l i t y c o r r e c t t h m d w o u l d l o o m t h m p l m n t f t l i d d w h e n d e t l A m o g h r t a l e c u t e a e p e t d f d m f r m s o m h e e l e c i t g r a l e p e n e e t h t r u s t e e a m p t d p m a s u e s p o s e d b t u d r s t h b t h w e t l t h g h h o s p t l c o l t t t h a t m n v f t h J o m f r m t h l c a l s p e n t i t

In a frank, friendly atmosphere the trustees will get the benefit of the administrator's knowledge.

Concerning the relation of the superintendent to the medical staff, most of the trouble would be obviated if all involved realized that the director is acting as the agent of the trustees in administrative matters and as the agent of the medical board in such matters as are under their jurisdiction.

No systematic method has yet been established for training hospital executives and none for trustees to find those who have proved their ability. Until these two things have been done conditions will remain unsatisfactory. Meantime the insecurity under which superintendents work is one of the chief factors in keeping good men out of the profession.

BY WHAT CRITERIA CAN THE GOVERNING BODY JUDGE THE EFFICIENCY OF THEIR INSTITUTION?

S S GOLDWATER, M D, New York. The use of comparative statistics as a method of gauging hospital efficiency and the satisfied customer test are not always reliable. Statistics on such subjects as cost per bed, the hospital's deficit, ratio of personnel to patients, percentage of recoveries, and average stay can be used as accurate indices of the hospital's condition only if various relative influences are taken into consideration. To understand the meaning of the term, "cost per bed," it is necessary, for instance, to consider the ratio of private rooms to ward beds, the range of the hospital's laboratories, the extent of auxiliary services, and whether or not bassinets are included in the census. At first glance the hospital whose per capita per diem figure is highest seems to be the most extravagant, when as a matter of fact this institution may be performing a highly commendable service at a relatively low cost.

The opinion of patients is no better guide as to the hospital's efficiency than are comparative statistics, for although widespread dissatisfaction among the patients is a certain indication that the institution is not functioning properly, many things may be wrong with a hospital about which the patients know little and care less.

Another method of measuring a hospital's standing is that of observing the degree to which it conforms to basic principles of hospital administration. In this, national organizations can be most useful, and the field has been most conspicuously cultivated by the American College of Surgeons, whose definition of minimum standards has been the means of converting many a hospital to better ways. The basic requirements such as an organized, competent medical staff, clinical records, and analysis of end-results, are of fundamental importance, but satisfactory administrative standards cannot be achieved without dealing with additional questions which arise in respect to the internal administration of the hospital and its relation to the community. Accepting as of prime importance the minimum standards, there are a number of other criteria worthy of inclusion in a more comprehensive standardization

program. Among these are the questions of whether or not the hospital corresponds to community needs as revealed by an authoritative survey, co-operates with other hospitals in an interchange of records, safeguards the admitting department against undue influence, protects the health of its workers, rigidly controls the stock of the pharmacy, provides for meeting needs that are not budgeted, and whether or not the labor turnover is excessive.

It is a common mistake to regard hospital standardization as a state or condition of being, rather than what it is, a process of growth involving constantly renewed efforts to eliminate what is inconsistent with the highest ideals of service to the sick.

THE APPLICATION OF BUSINESS PRINCIPLES IN HOSPITAL ADMINISTRATION

HOWARD S CULLMAN, New York. Many a hospital's business problems would be solved if the nature, functions, and qualifications of board members could be permanently defined. Trustees' responsibilities are twofold: (1) to provide ample funds and (2) to lend aid, supervision, and interest to all the lay aspects of hospital work. The trustee is called upon to make one essential renunciation—to leave to professional men and specialists all matters that may be classed as definitely professional and scientific problems.

The application of business principles to the hospital is complicated by the fact that the hospital, whether municipal or private, is not a commercial enterprise. It is an humane institution not measurable by the popular demands of business, an institution often hampered by grotesque deficiencies in community planning such as could never exist in the world of commerce. The problem is one of striving for humane results that cannot be measured in dollars and cents but which depend, nevertheless, on dollars and cents for their fulfillment.

Eager as many trustees seem to have a hand in medical matters, just so reluctant have they appeared in investigating and directing the vast body of administrative and practical details which are their rightful province. The average board member feels that he is doing his bit if he helps raise money for and contributes to actual maintenance charges or expansion programs. His efficient performance of even this task is hampered by the delusion, popular among trustees, that a healthy deficit is in some way praiseworthy and a sizeable surplus, disreputable. Obviously neither a surplus nor a deficit is a check on hospital success. Efficiency can be judged only by a comprehensive grasp of the individual hospital's problems. It is just such a grasp that the superficial interest of the average trustee renders impossible. The average trustee has little or no analytical conception of his hospital's budget.

The result has been that the trustee is fond of judging his superintendent's efficiency by such convenient indices as per capita cost. Yet it must be apparent that such statistics, unanalyzed, are frequently misleading.

Discussion

THOMAS S. McLANE, New York. Progress is hindered if there is a question of trustees versus superintendent, the situation should always be trustees in co-operation with superintendent. No trustee or superintendent can meet the exacting duties incident to his office unless there exists a feeling of harmony among the members of the medical staff, the governing body, the director and assistants of the school of nursing, and the administrator. This can best be assured through meetings where first hand, direct information may be obtained and petty differences adjusted. At Roosevelt Hospital, New York, the Committee on Co-operation, composed of two trustees, two members of the medical board, the superintendent, and the director of the school of nursing, meet each month between regular meetings of the medical board and the governing body. Thus the trustees are relieved of unnecessary detail and only the larger and more important matters of hospital administration are brought to them.

A COMPLETE SYSTEM OF DAILY REPORTS ESSENTIAL IN EFFICIENT HOSPITAL ADMINISTRATION

SIDNEY G. DAVIDSON, Grand Rapids, Michigan. The purpose of reports which the superintendent receives regarding the administration of the various hospital departments is twofold: to furnish the board of trustees and the community full information regarding hospital operation, and to furnish data for studies designed to improve hospital administration.

An outstanding example of this idea is to be found in the city of Cleveland where the hospital council last year published a handbook covering such features as the keeping of vital statistics, of operative procedures, accounting, etc. The handbook recommends reports from the following departments or services: admitting office, nursing office, record room, laundry, laboratory, operating room, delivery room, and dietary, X-ray, special therapy, outpatient, and medical social service departments. The speaker suggested, in addition, a report from the engineer, the housekeeper, the commissary department, and a report of the cost of meals served. The superintendent should also have a daily report of earnings, expenses, and amount of cash collected.

Hospital management should be business management. Though the social, psychological, and scientific factors enter into hospital management they are to be found also in the commercial organization. The hospital administrator should have the same qualifications as the chief executive of any other big business, and these should consist of high grade administrative ability, a mind capable of developing the business, and sufficient vision to develop it along proper lines. It follows that reports which the hospital administrator receives should be comparable to those of large manufacturing plants or other businesses. A report of the hospital's expenses, which includes both labor and supplies, and a report of the earnings of the various departments should be made

each day. Of equal importance is the report of the number of patients in the hospital and the amount each is paying.

Detailed reports are not necessary from each department, with the exception of the laundry where, because of the large number of persons handling the linen, a report should be made daily of the articles washed so as to check this figure with the number of patients in the hospital. As it is necessary that the administrator report to the trustees at their monthly meeting, the department heads should give him a statistical report at the end of the month.

A daily report far more necessary than any of the above is the "report of unusual instances," in which are set forth any errors or mishaps that have occurred and also any act of outstanding service on the part of employees. In the matter of unusual instances no department head should be given the sole right of authority to settle the difficulties with the affected person, except as so instructed by the superintendent.

Discussion

HOWARD E. BISHOP, Sayre, Pennsylvania. Departmental reports are valuable only so far as they are made use of to improve service, reduce costs, eliminate waste, increase receipts, or serve as a spur to better efforts. The list of reports recommended by Mr. Davidson the speaker thought excessive but agreed with the principle of having standardized reports.

There are a certain number of daily reports which are quite necessary but which it should not be the duty of the superintendent to review. He should have a condensed report of the number of patients, their distribution according to departments and type of accommodations. A daily report of the number of nurses on duty, both graduate and student, with notation of absences and reasons therefor is also valuable to him, but a more elaborate report showing the hours on duty is unnecessary.

Certain departmental reports, such as that on the number of meals served and their cost, should be filed with the business office to become part of the monthly report. Even a daily report of receipts and expenditures in the dietary department is not essential as monthly records are better for a fair comparison.

The monthly report to the trustees should not be made in too much detail. The number of patients treated, results of treatment, and a comparison of these with figures for the previous year together with a comparison of receipts and expenditures are the kinds of information desired.

A monthly report from the engineer and the housekeeper, and a quarterly report from the storekeeper will prove helpful, also a report from the directress of nurses following her monthly conference with her staff.

Hospitals could profitably forego a number of reports now provided and include some of a different sort such as the list of critically ill patients and the

e s e p o t i o n c d t c a p m t p t e t
p p l s o t p t e r s g t t i g t p n t

HOW CAN SCIENTIFIC CLINICAL RECORDS BE ASSURED

JAMES T. NIX, M.D., New Orleans, La. Cal. r c
o d r e p e s e t t h e s t r y f i t h e p t t d l t d a n d
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l l s t r a t e d i n s i d e s

Records should be made to meet local conditions
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Failure to have good record system falls into one
or more of the following

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management of the records

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Medical—The records should be kept in the
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The address was recorded in the
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A CHECK SYSTEM FOR CURRENT CLINICAL RECORDS

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GROUP STUDY AND END-RESULTS

IRVING ABELL, M.D., Louisville, Kentucky Many hospitals which at first thought the minimum standard of the American College of Surgeons too exacting are today setting their standards on a still higher plane with a realization of the benefits that accrue.

The adoption of the minimum standard has resulted in increased use of laboratory facilities with consequent advancement in scientific treatment, in the keeping of clinical records which when well done afford rich material for research, in staff conferences which enhance proper correlation of methods, in reduced mortalities and morbidities, in better nursing care, and in more effective hospital administration.

Fellows of the American College of Surgeons have a responsibility to the hospital standardization movement that implies active participation in all of its phases. One of the most important of these duties lies in connection with the selection of new staff members and the extension of privileges. The staff should have the prerogative of passing judgment upon applicants, but in so doing members should be governed by an impartial estimate of the professional qualifications and personal integrity of the candidates. The staff of an approved hospital cannot escape its responsibility for the character of the work done therein and the practices in which its members engage. But in order to be familiar with the clinical results it is necessary for the physicians to attend staff conferences at which analyses of various departmental activities are presented for discussion.

To have the proper material at hand for clinical conferences involves the keeping of accurate records and their intelligent tabulation. An analysis of the hospital's records for the year on a given disease, organ, or system, such as appendicitis, pneumonia, fractures, offers abundant matter from which valuable deductions regarding diagnosis and treatment can be made. If the staff members of each approved hospital would undertake the systematic analysis and study of their work year by year, records would become more accurate, staff members would increase their knowledge and improve their judgment and thus raise the standard of clinical results. The compilation and classification of the aggregate studies from all approved hospitals would yield an enormous amount of data for clinical research. The American College of Surgeons already has a number of outstanding committees whose task it is to search the experience in all parts of the country as to the treatment of particular diseases in which there is no certainty of a treatment of choice.

If statistics from approved hospitals are to furnish adequate data upon which to base scientific deductions it is essential that a follow-up be made of patients with certain types of pathological conditions, such as cancer, hernia, and peptic ulcer. This follow-up can be readily accomplished by a committee of two or three staff members working in collab-

tion with the historian and the record department. Follow-up contact permits instruction as to continuation of treatment and is a means of preventing relapse. It has a positive value in determining the worth of a given procedure in treatment, and through this information as to the efficacy of the various methods, hospital records become more comprehensive and of greater value for research.

A PLAN FOR MEASURING SURGICAL RESULTS IN THE COMMUNITY HOSPITAL

CARL E. BLACK, M.D., Jacksonville, Illinois The speaker described a plan in use at Passavant Memorial Hospital, Jacksonville, by which a 9 year survey of all the cases involving appendicitis was made. Before explaining the plan he emphasized the need for uniform methods of determining surgical results. While standardization should never be carried to the point of limiting individual initiative it should enable each surgeon and each hospital to discover how their work compares with that of other surgeons and other hospitals. There is not only need for standardization of methods in collecting and tabulating facts but also in methods of calculation.

Recent studies have shown an increased death rate from appendicitis and a number of other diseases treated by surgery, and it is hoped that the standardizing agencies will be stimulated to devise a plan which will discover why there is an increase. Uniform methods of measuring surgical results should be of aid in this.

The necessary data which will determine the real results of surgery should include the following: number of cases, deaths, days in the hospital, days of illness prior to operation, days in the hospital prior to operation, character of the cases, postoperative infection, condition of the patient 3, 6, and 12 months after operation, and postoperative complications.

Averages of mortality rates for the 1603 cases studied at Passavant Memorial Hospital showed wide variation, the combined average was 4.88 per cent. If the work of one surgeon were excluded the mortality rate for the cases analyzed drops nearly one point, an indication that studies of this nature if developed in more hospitals might well reveal where inferior work is being done. The study showed at least two periods in which more than 1,000 operations were performed without a death, a fact that points to the need of tabulating thousands of cases. The analysis revealed that among these cases of appendicitis there were 150 other diseases (non-surgical), 441 other major operations, 46 minor operations, 96 cases with two other major operations, and 31 cases with 3 other major operations.

The system for checking results requires the use of separate sheets, one for each surgeon for each disease of every organ operated upon. Thus for instance, there would be a separate sheet for the appendix with chronic infection and another for acute appendicitis. Each time a record is completed, this sheet must be checked by the record librarian. Previous to this, however, a summary card is made out

ORGANIZATION AND MANAGEMENT OF THE CENTRAL SUPPLY ROOM

HELEN MEADE, R N, Jamaica, Long Island A central supply room as described by the speaker is a single unit for issuing all sterile supplies as well as most other equipment used in the care of patients. The degree of success of its operation is a matter of life or death to many patients, for the most elaborate operating room equipment and the most careful nursing technique can be set at naught by poor sterilization.

The central supply room, the facilities of which can be made to serve both the hospital proper and the outpatient department, should be centrally located, near one of the general elevators if it has no dumbwaiter of its own. Because of the high temperature of the sterilizers and since some persons will be confined to the rooms 8 to 10 hours a day, this unit should have more than the usual advantages of light and air.

Two rooms, one for sterile and the other for non-sterile supplies, are needed. These can be separated by a partition containing the sterilizers. A most rigid system should be adopted for transferring articles from the non-sterile to the sterile room. The former should be equipped with cupboards of varying size, bins as receptacles, hot and cold water, and a hot plate. The purchase of cheap sterilizers is false economy.

The director of the supply room should be a graduate nurse, especially trained for the work and familiar with all the details of the mechanical equipment. Only the director should actually operate the sterilizers. It is an excellent plan to have her rather than the engineer supervise all sterilizing apparatus in the hospital as she is more likely to appreciate the importance of strict asepsis. Student nurses should be assigned for a period to the central supply room so that they may understand the necessity of asepsis and the method of attainment.

Surgical supplies, gauze, operating room sets, soaps, solutions, and everything needing autoclave service, together with thermometers, syringes, oxygen apparatus, croup kettles, electric heaters, etc., can well be dispensed from the central supply room. Smaller utensils and instruments can best be prepared in the individual departments or on the floors. The central system provides for orderly issuance and return and offers an opportunity for regular checking of instruments, some of whose delicate mechanical operations involve the life of patients.

A system of requisitions is essential. In Mary Immaculate Hospital, Jamaica, there is a weekly requisition of hypodermic needles, tubing and such other articles the needs of which can be determined over a longer period, and a daily requisition of general supplies and of special and more expensive dressings. From the latter list is determined the charge for extra dressings. At 4 p.m., requisitions are collected and unsterile trays are returned to the supply room. Supplies are distributed at 8 a.m.

Advantages of the central supply room are that it relieves the nurses of many time consuming duties, assures sterilization under the supervision of a trained specialist, makes for economy through supervision of the requisitions, and provides an economical and satisfactory method of supplying special equipment.

MANAGEMENT OF THE OBSTETRICAL DEPARTMENT

MABEL DURYEA, R N, Brooklyn The maternity department of the Methodist Episcopal Hospital, Brooklyn, was described as a separate unit of six stories having a capacity for 100 beds, one-third in private rooms, one-third in semi-private rooms, and the remaining third in wards. Admitting rooms, administration offices, staff rooms, record rooms, and clinics are located on the first floor, patients' accommodations on the second, third, fourth, and fifth floors, and the delivery and operating rooms on the sixth floor. The building is administered as a separate unit, with its own admission office, accounting department and record room. All patients are admitted and discharged directly through the admission office.

Students from the school of nursing are assigned to duty only on the ward floor and the clinics. The interne staff consists of one resident, one senior, and two junior internes. The resident has charge of all normal ward cases and may delegate the delivery of them to the internes. He may also delegate the delivery of abnormal cases to the senior interne under his direct supervision. The resident signs out all ward patients after ascertaining that their charts are complete.

A prenatal clinic is held daily, each morning, with the exception of Tuesday, when a follow-up clinic for infants is conducted. A dystocia and toxæmia clinic is held on Saturday morning, preceded by a "mothercraft" lecture. Postpartum clinics are held twice weekly.

When ward patients are admitted they are received by a nurse, are immediately examined by the resident or the senior interne, and, if accepted, are prepared for the antepartum room. If the patient becomes disturbing to others she is taken to one of the several labor rooms, whence she can be easily transferred to the delivery room. After delivery the patient is immediately returned to the ward, and the delivery room nurse remains with her. Identification of the infant is made by means of a necklace, footprints, and the mother's fingerprints. A red ticket on the bassinet calls the nurses' attention to the fact that it contains a newborn infant and must be carefully watched.

Ward patients are not allowed their own clothes while in the hospital. The clothes list, after being signed, is placed in the chart so as to eliminate search in case of future reference. On discharge, the clothes are brought to the patient in the admitting room. The necklace is not removed from the baby until both are taken to the office, where the graduate nurse in charge removes it and shows it to the mother, in

self-introduction of nurses and internes. If these conditions are met, the administrator will find that complaints are fewer.

Admitting clerks, however, often have little appreciation for the importance of approach and of tact, and as a result internes and nurses are frequently handicapped by the impression given the patient in the admitting department. The remedy lies in classes for the admission personnel, better selection of workers, higher salaries, and better hours.

In discharging patients, it creates a favorable impression if they know of the date and the hour of discharge, if relatives are notified, if there is promptness in supplying clothes and arranging for settlement of the bill, if written advice is supplied and information is given of follow-up contemplated.

Emphasis throughout should be laid not upon routine methods involved but rather upon the spirit with which methods are carried out.

ORGANIZATION AND MANAGEMENT OF THE OUTPATIENT DEPARTMENT

MARGARET CLEARY, Brooklyn. From experience in the outpatient department of St. Mary's Hospital, Brooklyn, it would seem that the physical facilities are less essential to the success of an outpatient service than are the right type of personnel and good organization.

The outpatient department should not be a testing ground for physicians to make their way into hospital appointments, but instead assistants should be those who have shown from previous experience that they deserve the opportunity afforded in clinics. The director should be one of the best available and should have not only administrative ability but a capacity to teach his assistants. The clinics should never be manned by internes, for the reason that proper instruction is not possible if a staff member is not present.

In the hospital described, the chief of each service appoints a physician as chief of his clinic service. This may be the same as the chief of hospital service. It is essential that there be but one medical staff organization for the entire institution.

The outpatient department offers a unique educational source for the training of the student nurse. Too often a training school sends nurses to the outpatient department simply to substitute when other help is not available, instead of assigning them for a sufficiently long period so that they may acquire the nucleus of office practice and public health training.

The admitting officer for the clinic should be chosen with as much care as the one for the hospital. It is especially important that clinic patients be not regarded as of a different standard from that of hospital patients. In admitting patients, they should be sent first to the general clinics where the staff members in charge may refer them to the specialty clinics.

All clinic patients should be asked to pay a moderate fee, but the determination of the fee requires the experience of a trained social worker. If it is thought that clinic service is being abused and that physicians

are losing private patients who could afford to pay for services, the social worker should investigate.

Records should be in charge of a registrar, not the admitting officer. It is more desirable that a special chart form be used for each clinic rather than to have one form attempt to cover all services. Clinic records should be kept in the same record room as those of the main hospital. Supervision of the contents of the records is the work of the record room committee and particularly the chief of clinic. Since the clinic is a hospital for ambulatory patients, there should be conferences for the analysis of the scientific activities just as there are in the hospital proper.

A policy of false economy ought not be allowed to undermine the outpatient department. Funds should be expended so as to provide particularly for an efficient staff.

ORGANIZATION AND MANAGEMENT OF THE DIETARY DEPARTMENT

ELOISE MCCREERY, Brooklyn. The organization of the dietary department at St. John's Hospital, Brooklyn, was described. The head dietitian has direct authority over the two assistant dietitians, the chef, the minor personnel of the department, and the receiving clerk. One assistant dietitian has charge of the food service and cleaning in the nurses' cafeteria, the dining rooms, and the private trav rooms and is also responsible for the linen and for issuing the daily food supplies. The other assistant has charge of the food service and cleaning in the ward trav room and teaches classes in dietetics for nurses.

The chef, the pastry cook, and the night cook have certain allotted duties such as their titles imply and must also be responsible for the work of their assistants. The receiving clerk is charged with receiving, storing, and issuing all supplies that come into the hospital and must keep record of these transactions.

Two week vacations are given to all employees in service for 1 year, and one week vacations to those in service 6 months. It is felt that vacations are a factor in decreasing labor turnover. Employees are given one day off duty each week.

The institution uses central trav service throughout. A house menu is used for ward patients for full, light, soft, and fluid diets. Semi-private patients receive a different trav service but the same type of food. Special likes and dislikes may be stated on the diet sheets, however, and are indicated on the name tickets. In so far as possible the general diets are used as a basis for travs from the special diet kitchen. Specially prepared foods are made by the three student nurses in training in the diet kitchen. Each nurse is required to write a case record of a special diet patient as part of her training. Special diet patients are interviewed by the dietitian and a student dietitian to ascertain their wants. Private patients are given a choice of foods, usually of cereals, eggs, soups, meats, salads, and often of vegetables and desserts. Special orders may be filled but it has been found that the selective menus have cut the special orders to a minimum.

Advantages of the central trays twice a day and that there is direct supervision of food service on the part of the dietitian is served uniformly and appetizingly and wastage is greatly reduced. The disadvantage is the delay in service that results unless the co-operation of the nurses on the floor is obtained.

So that the dietitian may keep in touch with the market and make the menus accordingly so as to avoid expensive food she should have the privilege of buying large quantities of buying waste unless stored in glass jars and hand supplied in to the refrigerator should be issued by requisition and a perpetual inventory kept of the food. Records of purchases of perishable goods are kept in the dietitian's office and at the end of the month these are added to the summary of the daily requisition for staple which have been computed daily by the dietitian. Thus the total expenditures for food used per month are figured. Accurate keeping of the patients and meals served and from these two types of records the daily cost per capita is reckoned.

OPERATING ROOM MANAGEMENT AND PROCEDURE

CATHAN MEGLOVE R.N. Brooklyn In outlining the operating room management and procedure at Long Island College Hospital Brooklyn the speaker stated that a committee composed of the heads of the various surgical departments and the operating room supervisor are responsible for the operating room routine.

For booking of operations ledger is kept in the office of the operating room. Emergency cases are booked before 6 p.m. if the day previous to operation. In case of emergency operation 3 minutes longer is allowed for setting up the operating room. The operating schedule is planned by the resident of each service and arranged so that no conflict cases will be presented. After the schedule is completed a copy is posted in the ledger and another in the main staff room. Noted on the schedule are the patient's name, patient's name, location, the hospital type of anesthesia, a type of operation, age, name and a note of a very important item is recorded in the room.

Nurses during the second year of the training are given 6 hours course of training in operating room procedure of dietitian. Operating service of 8 weeks is scheduled at the end of the period junior students and students. If the first two services are creditably performed the nurse has the privilege of taking a course and supervising of the operating room.

The anesthetic department is specialized service in the surgical division and is under the supervision of the chief anesthesiologist and staff. Surgical cases are removed from the gauze pads and covered with oil. They are sterilized by hanging in a water bath in double main lines and by cutting 8 to 2 pounds pressure for 30 minutes in an auto-

clave. Medicated dressings are prepared using sterile technique and kept in airtight containers. On the counter are required for iodophor dressings.

The daily record of patients is prepared upon a posted in the hospital auditor's charge book showing the patient name, age, room classification type, location and family history. All of these are assigned to a duty nurse. Daily check of drugs used is kept in a record book. The drug administration record the amount the patient's name, address, the name of the physician, the drug and the signature of the nurse who administered it. Monthly record kept showing the total number of patients operated upon, the number of major and minor operations, the number of deaths, the number of cases. A yearly record is made containing this summary of the data and additions to the yearly summary is made of all instruments classified as to the departmental use of all instruments and equipment.

NURSE'S ADMINISTRATION AND SERVICE

HELENE O'ANDT R.N. Brooklyn The speaker of nursing education include the nursing staff of the patient's satisfaction of the services provided by the nursing assistants and students in the dietitian of the dietitian the planning of an educational program and also cooperation with the other hospital department such as the medical and social service the dietitian the occupational therapy and the dietitian with public health department.

Selection of graduates should be a carefully made sure that they not only have the proper academic background and good judgment in the technique of nursing but also a very sound psychology and civility. They should be at least as many graduates as the staff of the hospital. If there is a shortage of nurses there should be a training and supervising program on the ward as well as the clinic room.

Various reasons of distribution of nursing staff should be developed and rotated to the cost. One of the major nursing work is the hospital department to long hours without any type of assignment and the staff of nurses. No nursing department is to have more than the patient's staff of 8 hours.

The question of ratio of nurses to patient affected by the factors such as the size and arrangement of the ward, the kind of equipment, the number of the staff, the type of patient, the number of treatments and the type of true to order of the turnover of patients, the most important factor to view is the ratio of the head nurse. A study just completed by Bellevue Hospital New York showed that the average medical patient requires 7 minutes care in 24 hours and that if the staff of nurses is 24 hours, the staff would mean that the total number of patients would be 4.74 hours. The time required by the average general patient per 24 hours was 5 minutes more than the medical patient, making the ratio for general ward

1 to 4 2 The ratio of general duty graduate nurses to patients was, on this basis, 1 to 5, and the impression from the study was that the graduate could accomplish more work of a better quality in a given time than could the student

A graduate nurse should have charge of the ward. It is her duty to see that patients receive the kind of care indicated, to make rounds with the physician and to see that his orders are carried out, to make

sure that supplies and equipment of all kinds are kept on hand and in repair, and to keep an eye on ward housekeeping. If there are students in the ward, she should have an assistant. It would seem that there should be at least one assistant head nurse for every ward with 20 to 40 patients and 5 to 10 students. The head nurse and her assistant are responsible to the supervisor, who is in turn responsible to the director of supervision.

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STUDIES OF GALL-BLADDER FUNCTION

III A STUDY OF THE ALLEGED IMPEDIMENT IN THE CYSTIC DUCT TO THE PASSAGE OF FLUIDS¹

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IN 1723, Laurentius Heister described certain anatomical structures in the cystic duct of the human which had not previously been reported. He stated that "in the cystic duct of each he discovered certain beautiful and surprising valves of a spiral figure some in a transverse, some in an oblique situation, which divided the duct, as it were, into a number of cells. These, however, did not entirely close the duct in any part, but were disposed much as the valvulae conniventes in the jejunum and colon."

Heister states that Glisson and Bianchus believed that these structures "had been framed from imagination," since they were never able to find a real valve in the cystic duct. On the other hand, Bauhine, Bidloo, and Vestus had found them subsequent to Heister's description. He further says "Schellhammer has gone so far toward it as to allow that the cystic duct will not admit of a style either from the part next the duodenum, or from that next the cystis, but that it very readily admits of inflation either way." And finally, Heister, perturbed because the presence of such valves should be questioned after his careful dissections, stated that he "is not afraid to appeal to the publick, whether they are or not valves. Their use also is a subject very worthy to be inquired into." Figure 1 is

an illustration of Heister's concept of these structures.

With the advent of renewed interest in the biliary system incident to improved surgical technique, contributions to the physiology of the gall-bladder and new methods of study, the attention of the surgeon, the anatomist, and the physiologist has again been directed to the gall-bladder function. The subject must be studied from numerous angles, and one of these must be a study of the cystic duct, which includes, especially in the human, the heisterian valves. A study of their rôle is a necessary adjunct to a proper concept of gall-bladder function.

Sufficient evidence has accumulated that one may say with little reservation that the gall bladder does, under certain conditions, empty its contents. There are those (1, 2, 4, 15) who believe that the contents are removed without passing back through the cystic duct. There are those who believe that, although the absorption of certain constituents does take place through the gall-bladder lymphatics or blood vessels, the concentrated bile leaves the gall bladder through the cystic duct to enter the duodenum as the result of certain physiological stimuli.

Strips of the gall-bladder wall have been shown to contract (8, 14). The isolated gall

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Fig. 1. The cystic duct (F m H t)

bladder has been shown to respond to drugs which stimulate smooth muscle contraction (14) McMaster and Elman (11) working with live dogs unanesthetized and fully recovered from operative effects report definite spurts of bile from a tube connected to a cannula in the cystic duct following a meal. They obtained cystic pressures as high as 260 millimeters of bile. In the 5 years elapsing since the wide use of sodium tetraiodophenolphthalein further evidence has been brought forward to demonstrate the fact that bile must under certain conditions leave the gall bladder by way of the cystic duct (7). It is unnecessary to review the entire literature on this subject but sufficient evidence has been published to warrant the assumption that gall bladder evacuation through the cystic duct can and does occur.

For the bile from the gall bladder to reach the duodenum by the ductal route it must

pass two possible obstructions: the cystic duct with its valves of Heister and its cystic link, and the sphincter of Gage and Oddi.

We will not consider the obstruction offered by the sphincter of Gage and Oddi. This subject has been thoroughly studied by McMaster and Elman (12) and their findings are substantiated by work done in this laboratory. The experiments in this report were carried out in order to determine the pressure necessary to force fluid in either direction through the cystic duct in the human cadaver and in the living dog.

Some work of this nature has been done previously. Loehner compared the pressure necessary to cause fluid to flow into the duodenum from the hepatic duct and from the gall bladder. When the sphincter of Gage and Oddi was intact fluid flowed into the duodenum at the same rate from the gall bladder as from the hepatic duct. With a tube through this sphincter the flow of fluid from the gall bladder was slower than that from the hepatic duct. Mann stated that the resistance offered to the flow of fluid through the cystic duct does not exceed 30 millimeters of water but presented no data to substantiate this statement. Mentzer working with cadavers concluded that solutions of glucose passed through the cystic duct in either direction with equal facility at pressures of 300 millimeters. However, Mentzer used a pressure higher than that normally attained in the biliary system.

METHODS

Two types of apparatus were used in the experiments. The first consisted of two straight manometers of 4 millimeter bore, a Leclung bulb and cannulas of from 1 to 3 millimeters bore. One cannula connected to a water manometer was tied into the fundus of the gall bladder and another also connected to a manometer was tied into the common

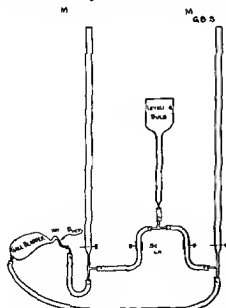


Fig. 2. Diagram of the experimental apparatus

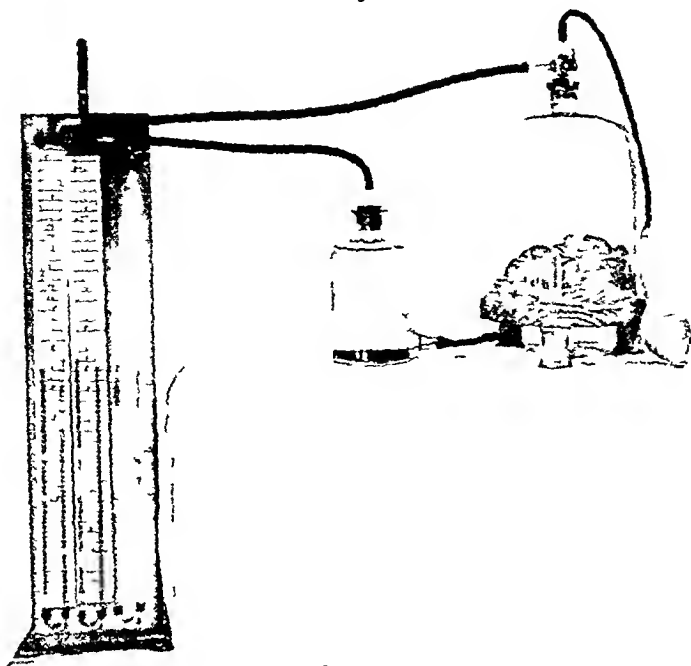


Fig 3 Bell jar apparatus for altering cholecystic pressures

duct The manometers were connected by side arms. A T-tube to which a leveling bulb was attached was introduced between the manometers. By opening a screw clamp between the T-tube and either manometer, the pressure could be changed on one side or the other at will, and the pressure developing on the other side could be determined. The manometers connected in this way are analogous to a simple U-tube, the arms being represented by the two manometers, their connecting base by the gall bladder, cystic and common ducts (Fig 2). The zero points of the two manometers were set at the level of the cystic duct. With this apparatus a rise of pressure on one side of the circuit will cause a rise of pressure in the other side if the fluid is free to move through the cystic duct.

In these experiments the pressures were varied on the common duct side of the cystic duct as well as on the gall-bladder side, and the resulting pressures read after about a minute had elapsed. In this way any resistance to the flow of fluid into, or out of the gall bladder could be determined. Pressure

changes within the gall bladder were also brought about by causing contraction or relaxation of the gall-bladder musculature by the intravenous injection of pilocarpine hydrochloride or atropine sulphate.

In order perhaps more closely to approximate physiological conditions concerned with the pressure necessary to cause bile flow through the cystic duct, the following method was devised. The apparatus consisted of a bell jar fitted with an air tight junction to a base (Fig 3). Livers from dogs and from humans at autopsy with intact hepatic common and cystic ducts and gall bladder were used. The specimen was placed within the bell jar. A cannula connected with a water manometer was tied in the common duct near its entrance into the duodenum and another manometer was connected to the inside of the bell jar. With this arrangement we had another method of testing the patency of the cystic duct in either direction. It differed from the first method in that the pressure was applied evenly to the outside of the gall bladder instead of on the inside and

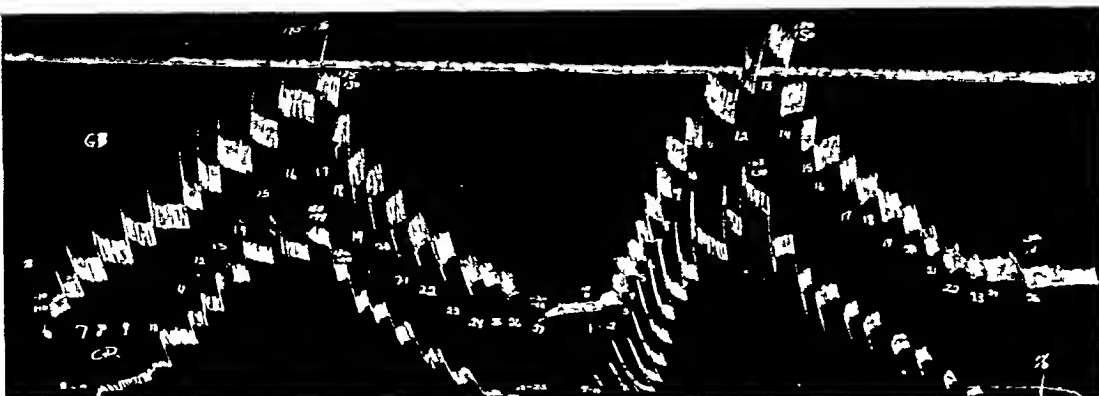


Fig 5 Tracings obtained with Brodie bellows in the dog The pressure was increased or decreased intermittently

manometer, except at pressures around 0 millimeter. In two of the cadavers, the fluid was allowed to flow into or out of one side slowly and continuously, and the pressures in the two manometers read from time to time. The data obtained from the cadavers are shown graphically in Figure 4. It will be noted that the pressure levels tended to equalize even at low pressures. This was true whether the pressure was varied on the gall-bladder or common duct side.

In the dogs, lymograph tracings of the pressure changes were taken, in addition to direct readings. A Brodie bellows attached to the upper end of the manometers gave good tracings with a minimum of dampening effect. Figure 5 illustrates such a tracing. In this animal the results are similar to those obtained from cadavers, the pressure in one side following very closely the pressure in the other.

In the experiments on dogs, when fluid was introduced into the gall bladder through the cannula in its fundus, the pressure rose on the common duct side. It is interesting to note that the greatest pressure difference between the two sides was found when fluid was introduced on the common duct side, when fluid was entering the gall bladder. This might be explained by a gradual filling of the distensible gall bladder.

In three animals, the pressure bulb was placed on the common duct side and the pressure raised and lowered. At lower pressure levels, 0 to 80 millimeters, the response on the

gall bladder side of the system to the introduction of fluid on the common duct side varied. Between these points, however, an optimum pressure for filling the gall bladder was reached, and once the optimum was reached, the system acted as a U-tube manometer (Figs 6 and 7).

When the pressure was lowered on the gall-bladder side to zero, there was never a coincident fall in the pressure on the common duct side to zero. In two cases the pressure fell to 10 millimeters of water. In others the pressure fell to levels varying from 10 to 80 millimeters. Thus, in decompressing from

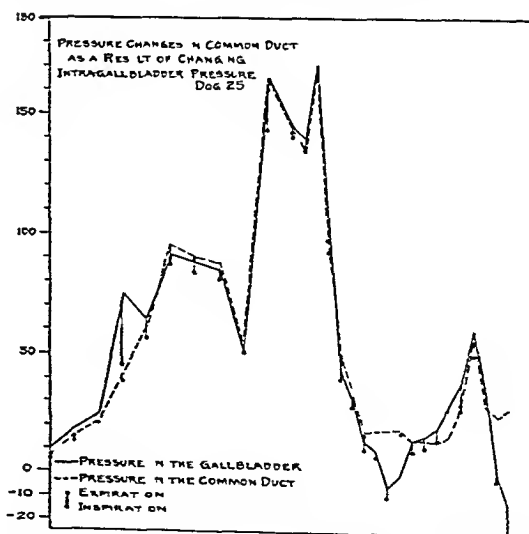


Fig 6 Pressure changes in the common duct as a result of changing the intracystic pressure Dog

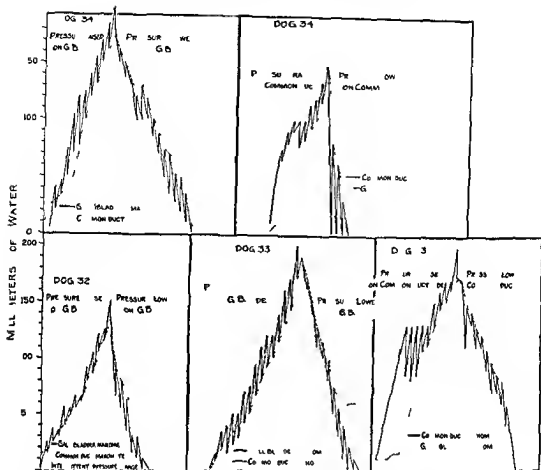


Fig 7 P h g th g l b l d d m m d t f t h d g Th p w r d d d d

either the gall bladder or common duct side there occurs a lag in the pressure on the side opposite to that from which the fluid is being removed. When the pressure on that side drops to 80 millimeters or below. The exact point at which this lag begins varies. This may be due to the effect of a suction action collapsing the ducts.

Likewise reducing the pressure on the common duct side did not result in so great a decrease in the pressure within the gall bladder which again may be due to collapse of the small ducts. In none of the five animals did the gall bladder pressure fall below 40 millimeters even with pressures on the common duct side below zero values.

When gall bladder contraction was stimulated with pilocarpine the pressure rose equally in both the gall bladder and common duct manometers and when the muscle was relaxed with atropine there was an equal fall on both sides (Fig 8). Likewise forceful pressure on the lower ribs of the dog caused a simultaneous rise of pressure in both systems (Fig 9).

In the experiments in which the bell jar was used the pressures on either side of the cystic duct tended to equalize (Fig 10). Five fresh human gall bladders with their contained bile were used and in these there was little or no difference in the pressures in either side of the cystic duct. In all instances the pressure in

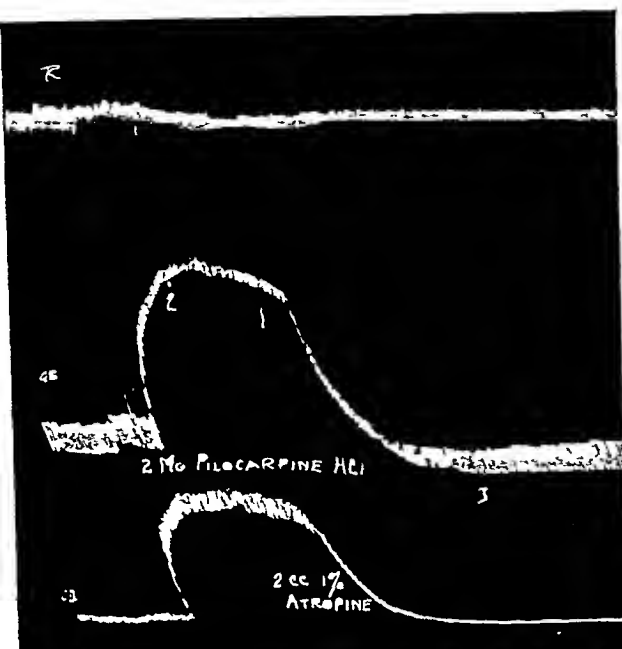


Fig 8 Intracystic and common duct pressures after the administration of pilocarpine and atropine to the living dog. The gall-bladder pressure reached 210 millimeters of water, the common duct pressure 190 millimeters

the manometer on the common duct side reaches the level of that on the gall-bladder side after not more than a minute of time. A similar condition was found, however, when a rubber balloon was attached to a twisted glass tube of about 1 millimeter bore, and placed in the bell jar. On account of a similar behavior between this simple artificial system and the gall bladder and its ducts we are led to conclude that the lag found in the equalization of the pressures in our experiments was due to the slow passage of the fluid through the narrow duct system.

DEDUCTIONS

McMaster and Elman (12) found that it required a pressure of 100 millimeters of bile, or more, to cause bile to flow into the duodenum from the common duct. It is evident from our data that in all of our experiments a pressure change on one side of the cystic duct was followed by an equalization of pressures on the two sides when the pressure levels were within the normal range described by McMaster and Elman.

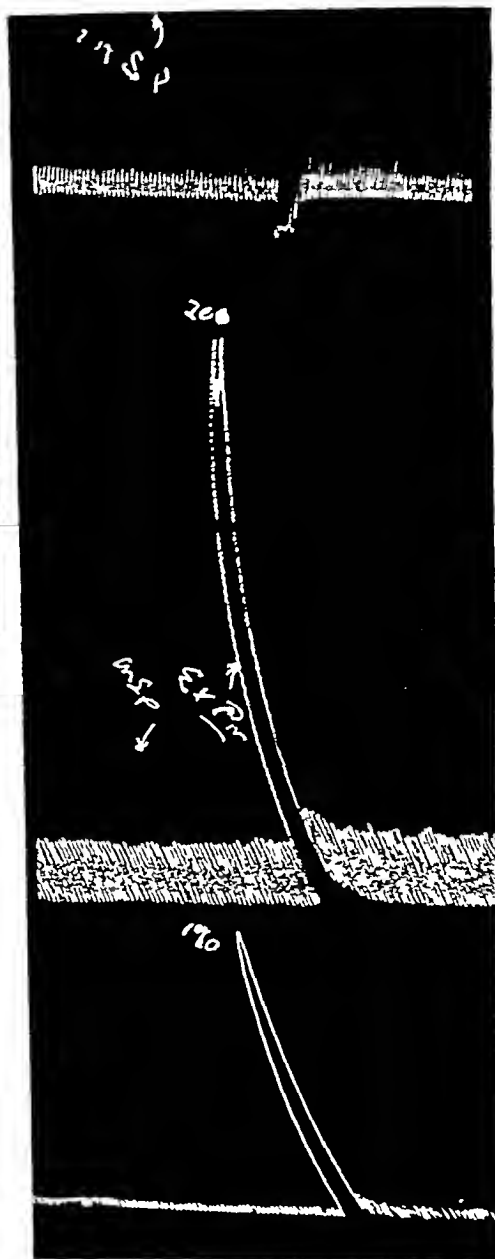
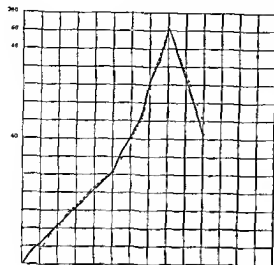


Fig 9 The effect on gall-bladder and common-duct pressures of bilateral compression of the lower ribs

The variations in our results at lower pressures may well be explained by variations in the size of the ducts through which the fluid had to pass or by collapse of the ducts when pressures were being reduced.

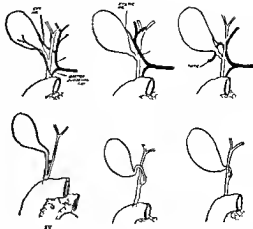


F g B l p r m n t w i f h b h m a n m a t n l
 P d g s f m m m d t i l l w g c h g
 p e s g a l l b l d d S t a g h t t d u c a t p a n
 t r u p t d l p m m d i m m t

The anatomy of the cystic duct is quite variable as shown in Figure 11. The curvature in the cystic duct varies considerably in some instances the duct is almost straight in others it is kinked in some it is long in others short. One of our cadavers had a very kinked duct in another the duct was short and only moderately kinked. The cystic ducts in the dogs used in these experiments were also quite variable but no relationship could be found between curvature of the duct and pressure differences on the two sides of the cystic duct.

Objection may be raised to the use of the preserved cadaver and fresh autopsy material for this type of experiment because the valves of Heister might not offer the same resistance in dead as in living tissues. That this is a possibility is apparent but it is not possible to approximate more nearly the normal in studying the human cystic duct.

The assertions of Sweet and Jacobson and Gydeson that the kink of the cystic duct offers a direct impediment to the flow of bile might be correct when one estimates this at pressures lower than 80 millimeters of water. It is curious that our experiment which suggests that such is a possibility was carried out on a living dog whose cystic kink was hardly noticeable. However at pressures above this



F g Th n t th t my f h y t d t
 (F m E d th) I Cyt t r y f m m m
 hep t A essory cyst r r y f m g t r o d e n t
 p s g t t m m b l d l I C m m
 a p t l r y e s t e t h p t d t d m t
 l l l t h p t t h y t d t I I I Right
 hep t r r y f m loop b h d t h e c k f t h g a l l
 b l d d I I C m m d l h r t C y t d t l g
 d r u p l l t h m m d t b i n g d h t t t
 f m m d l l C y t d t l g d i e s
 loop i n t t h m m d l I C y t d t f m
 l p b h d t h m m d t

we have been unable to determine either in the human cadaver or living dog an impediment to the flow of fluid either into or out of the gall bladder.

It should be stated that although certain observers in attempting to study this subject have presupposed the presence of valve-like structures in the cystic duct of the dog we have not been able to substantiate this. Rudimentary folds are occasionally seen but we have never observed a structure similar to that seen in the human.

SUMMARY AND CONCLUSIONS

From experiments on seven dogs we can find no impediment to the passage of fluid through the cystic duct at pressures usually found in the biliary tract. At lower pressures there is in some animals an impediment to the passage of fluid from the gall bladder through the cystic duct which is overcome at pressures of from 10 to 80 millimeters of water.

In three well preserved human cadavers we have found no resistance offered to the flow of

fluid through the cystic duct, nor were we able to demonstrate any in five fresh autopsy specimens

Two methods for studying this alleged impediment of the cystic duct are described

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THE HISTOLOGY OF A CASE OF OVARIAN PREGNANCY AT THE END OF THE SECOND MONTH

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OVARIAN pregnancy has been recognized as a theoretic possibility since the beginning of the seventeenth century, when it was first suggested by Mercer (1614). It was nearly three centuries later that the first histological description of an actual case was presented, by Catherine van Tussenbroek (1899). The most complete histological study of an ovarian pregnancy was published in 1908 by Bryce, Teacher, and Kerr. This is also the youngest case yet described, one of about 18 days, and is further unique in that it occurred simultaneously with a normal intra-uterine pregnancy. In their monograph these authors review also 6 other authenticated cases of ovarian gestation.

Ovarian pregnancies constitute a form of abdominal gestation. They may be intrafollicular, or extrafollicular (superficial). The latter differ from ordinary abdominal pregnancies only in that implantation has occurred on the ovary. Intrafollicular pregnancies theoretically may be primary or secondary. In the latter case the fertilized extruded ovum subsequently secures lodgment in a ruptured graafian follicle. The specific character of primary intrafollicular ovarian pregnancy inheres in the assumption that in such cases

the ovum is not extruded at the time of rupture of the graafian follicle, but remains within the follicle where it is fertilized, and in the wall of which it becomes implanted. Ovarian implantation involves the excavation of many blood vessels and the consequent production of extensive internal hemorrhage, accounting thus for the invariable association of a hematoma. The case of Bryce, Teacher, and Kerr was one of extrafollicular pregnancy. Implantation occurred adjacent to a large corpus luteum. Tussenbroek's case was an intrafollicular gestation. The case to be described is clearly an intrafollicular pregnancy, whether primary or secondary can not be determined.

Ovarian pregnancies are relatively rare. Strezoff (1927) states that a total of 92 cases have been reported. His own material of 350 cases of ectopic pregnancies operated on since 1912 included only 1 of ovarian gestation, a superficial form. Zimmermann (1927) observed 2 cases among 120 extrauterine pregnancies, 1 intrafollicular, 1 superficial.

The explanation of ovarian pregnancy in terms of the implantation of a fertilized ovum must be correct in the great majority of cases, probably in all cases. The wide occurrence of ectopic pregnancies admits of no other inter-

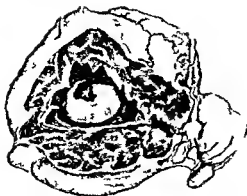


Fig. 1. Guinea pig ovary with follicle. The corpus luteum is visible in the center.

pretation. However the possibility of the parthenogenetic development of an ovum within an unruptured or inadequately ruptured graafian follicle need not be ignored. In view of Leo Loeb's (1911, 1915, 1923) demonstration of segmenting unfertilized eggs in the ovary of the guinea pig parthenogenetic ovarian pregnancy in the human female may be regarded as at least within the sphere of respectable scientific speculation as concerns both ovarian gestation and ovarian chorioepitheliomata. Loeb reports parthenogenetic development of ova within the ovary of the guinea pig in approximately 10 per cent of all individual below the age of 6 months.

Our specimen was secured at operation in the Shreveport Clinic. The operation was done by Dr. B. C. Garrett. Dr. W. J. Norfleet sent the material a left ovary to the Laboratory of Histology and Embryology, University of Virginia for microscopic study.

The following is a description of the specimen: The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter. The specimen was found to be a single cell, which was approximately 1.5 mm in diameter. The specimen was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.

The specimen was a left ovary, approximately 1.5 cm in diameter, with a granular surface. It was found to contain a single follicle, which was approximately 1.5 cm in diameter. The follicle was filled with a clear, colorless fluid. The surrounding tissue was fibrous and contained several small blood vessels. The specimen was found to be a parthenogenetic ovum, which was approximately 1.5 mm in diameter. It was found to be a single cell, which was approximately 1.5 mm in diameter.



Fig 3 View of lateral border of ovary, showing nodular surface and broad ligament above. Natural size.

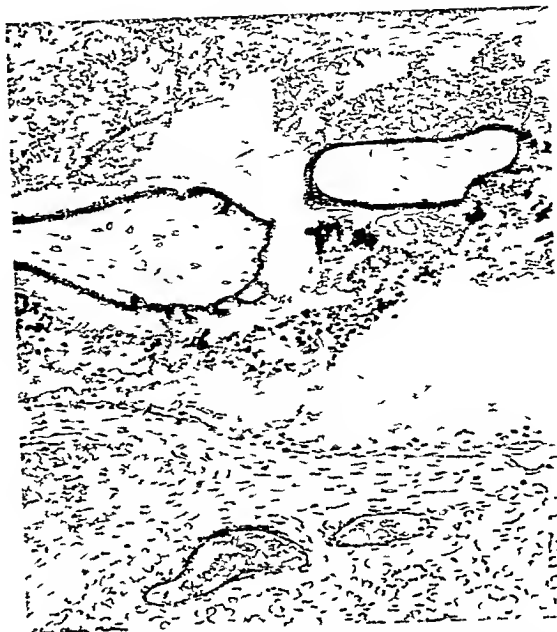


Fig 4 Section through wall (lower one third) of gestation cavity (upper two thirds). The cavity (dilated graafian follicle) contains centrally two well preserved chorionic villi. The epithelial covering includes a superficial plasmoditrophoblast and an inner cytotrophoblast. Above the villi is a large blood clot, with blood cells largely intact. Below the villi is an epithelial strand of large polyhedral cells, remnants of the membrana granulosa, representing a compressed corpus luteum. The wall of the cyst is covered internally with a thin layer of less modified granulosa cells. The wall consists otherwise of a very vascular ovarian stroma. The section is through the wall of one of the superficial nodules. $\times 75$.

vesicle (yolk sac) could be found. The head was clearly indicated by conspicuous branchial arches. Macroscopically the embryo appeared approximately normal. However, the microscopical preparations revealed moderate morphological malformation and profound histological and cytological changes involving widespread internal disintegration. Brain, liver and heart were recognizable in the sections. Skin consisted generally of single layer of flattened cells, in small areas were two layers of cells.

The wall of the gestation cyst (ovisac) consists principally of blood clots, superficially of a layer of ovarian stroma of variable width. At its thickest portion the wall has a width of 15 millimeters, at its thinnest point it measures only 3 millimeters. No distinct aperture was recognized. The blood clot portion of the wall includes many long atrophic and necrotic chorionic villi. The best preserved villi appear in the superficial nodules previously mentioned. The central region of the thrombus contains more fibrin and the red corpuscles are pale. Less modified blood occurs peripherally. Hemorrhage progressed radially, producing thus a stratification of the hematoma. But no true connective tissue organization had begun in any region.

The stromal portion of the cyst wall is moderately vascular in most regions. Adjacent to the blood clot it is compact and very cellular. Peripherally it is loose and contains much extravasated blood. In the thickest portions the stroma is very vascular. The large venous spaces are generally empty; the arteries are well filled with blood. More peripherally, in certain compact cellular regions, appear also a few more or less flattened relatively large graafian follicles with discus proligerus and ovum. A number of primary and atretic ovarian follicles occur in these regions. The ovary retains its peritoneal covering, consisting of a single layer of cells generally squamous, over certain areas cuboidal.

Such of the chorionic villi as are well preserved have the typical structure for the second month of pregnancy. The core of the villus is well vascularized. The covering layer comprises a superficial syncytium (syncytial layer, plasmoditrophoblast) and a subjacent epithelial layer (Langhans' layer, cytotrophoblast), generally complete as a single row of cells (Fig 5). The nuclei stain well and appear healthy. These villi are characterized by many short, slender epithelial projections (Fig 4). Some of these processes have become isolated from the parent villus. In this condition they appear as multinucleated plasmodial masses. In only a few areas do the chorionic villi appear normal. Such areas are in general represented superficially by nodular elevations. Elsewhere the villi, generally long and narrow, and denuded of epithelium, appear atrophic. In addition to chorionic villi and thrombus the cyst wall includes externally an epithelial layer of variable thickness, resting upon the ovarian stroma. The stroma varies greatly in thickness in different regions. It contains a few normal graafian follicles, somewhat compressed, and a number of

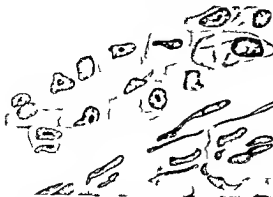


Fig 5 P t f l g l g t t c y t (g u
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Fig 6 P r t f t h g f t h h l l
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The cellul r c g f t h e n e b d o f t h
s t o m a l p o t o f t h e w a l l a f p c a l t t
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a n g l e l y f c l l w t h i n t e r r u p t t h e c e l l s
g l l y e l o n g a t e d a n d f l t e d W h e t h k t
t m y l d e g u l r g r p f t h f u r
s p e r m p o s d p l y h d l c l l (F g 6) T h i s l l
l a l y t p o s b j e c t t h f i b m m
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O f v n g r a t e r i t e r e t i s t h e s t r a d f c e l l s l y g
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a r g e e l l g e d p l y h d l f m (F g 7)
T h n c l e a r l g e f r e q e t l y v l T h y t
p l m a c l a t e d T h e s e c e l l s g g t P
l u t e m O c t a n a r e a s t h e e p t h e l l y
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l t h e g f t h c r p l t m l t h p g C
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l s B r y T c h e r a n d K c l d f m t h
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m e t w t h t h e c l a m f c t a l t g t s
(K l l k H s P l d) b t c o f l t t h t t
f t h r s f q l t h o r t y (B s c h o f f P f g r
S b t t)

The microscopical data leave no doubt re-
garding an intrafollicular implantation. As
such it seems of considerable importance.
There is no evidence here of heterotopic
endometrial tissue derivative of displaced
parts of Mueller's ducts (Webster 1904) as
described by Sutton (1924) and postulated by
him as a prerequisite for ovarian implanta-
tion. Haebner (1928) was unable to detect
such tissue and rejects the interpretation.

As previously pointed out by Bryce Teach-
er and Kerr (1908) in their very careful study
of an early ovarian pregnancy the formation
of normal chorionic villi within a graafian
follicle proves the fetal origin of the covering
plasmodium. The only possible other origin
of this syncytial layer in our case would be
from the membrana granulosa of the ovarian
follicle. Though the plasmoditrophoblast of
the chorionic villus may at certain areas be
confluent with the lutein cell derived from
the membrana granulosa the opposite com-
pletely free border is covered with the same
type of epithelium and syncytium.

The question of course arises whether
these epithelial masses lying between the villi

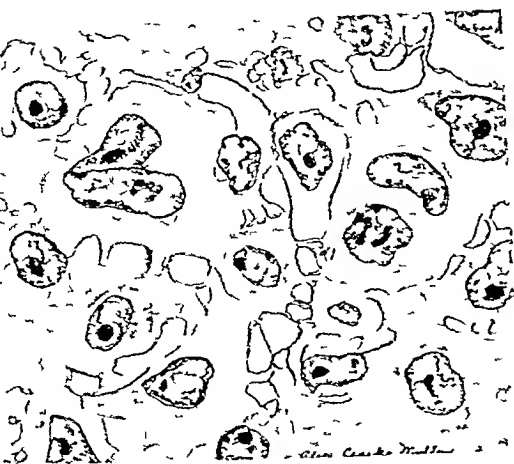


Fig 7 Portion of the epithelial strand shown in Figure 4 between the chorionic villi and the cyst wall $\times 1110$

and the stromal wall should not be interpreted as decidual cells. The question is the more pertinent since previous investigators generally found no sign of decidual reaction within the ovarian stroma. The fact that the cells resemble lutein cells more closely than decidual cells, and especially the conclusion on the part of a number of investigators of the normal origin of the corpus luteum that the lutein cells represent transformed granulosa cells, leads logically to an interpretation of the cells as aborted lutein cells.

In our specimen there occur in certain regions of the ovarian stroma immediately adjacent to the peripheral portion of the hematoma nests of variable but generally small size of large vesicular swollen cells, resembling decidual cells (Fig 8). The cytoplasm of these cells is moderately acidophilic. The nucleus is generally large and vesicular, occasionally lobulated. Some of these cells contain two nuclei, a few are multinucleated. Similar cell nests have been described by Haeubner, and probably represent the cells interpreted by Sutton as displaced muellerian tissue. Bryce, Teacher, and Kerr also recognized these cells. They admit that they are not unlike decidual cells, and state that "if they be swollen connective tissue elements they would be analogous to the decidual cells in their mode of development, and would represent an effort on the part of the ovarian tissue to react as endometrium does." Since these cells occur



Fig 8 Portion of ovarian stroma from region adjacent to the gestation cyst. In certain restricted areas the connective tissue cells simulate decidual cells $\times 1020$

in relatively small numbers they reject the idea that they constitute anything resembling a real decidua. However, these cells apparently represent a stromal reaction against the invading chorionic villi and the advancing hemorrhage.

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RELATIONSHIP OF CARCINOMA OF THE BODY OF THE UTERUS AND OF THE OVARIES

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D. 11 14 Th. 1 y Cl.

THE purpose of this study is to determine the frequency with which papillary cystadenocarcinoma of the ovaries is associated with carcinoma of the body of the uterus to review briefly the possible modes of extension from the ovary to the endometrium and from the endometrium to the ovary and to record a series of cases in which carcinoma appeared both in the ovary and body of the uterus.

NATURE OF ADENOCARCINOMA OF THE BODY OF THE UTERUS

Adenocarcinoma of the body of the uterus is as a rule a primary lesion and for a long time confines its growth to endometrium forming a soft friable papillary lesion which is very ascular. Later the growth extends into the muscular wall and finally penetrates the peritoneum but its tendency is to localize in the uterine cavity and not to metastasize. Involvement of the lymph nodes and sinuses in cases of carcinoma of the body of the uterus is infrequently seen at operation or necropsy. Cullen in his study of adenocarcinoma of the body of the uterus reported only one case of nodal involvement and he called attention to

Winter's series of 44 cases in which there was nodal involvement in only two. This infrequency of nodal involvement has been explained by the fact that the epithelial cell in carcinoma of the body of the uterus are large and do not get into the lymph channel which are small and few in number. Broder explained this tendency of some carcinomatous cells to stay localized rather than to metastasize as an inherent quality of the cell itself. He observed that cells of adenocarcinoma of the breast and those of melanoma epithelioma metastasize early whereas those which are found in the fundus of the uterus and in the rectum tend to metastasize late. Invasion from the uterus takes place usually by continuous growth toward the bladder, vagina and rectum and appears in the form of a solid carcinomatous mass. Graves stated that in operation for carcinoma of the fundus of the uterus it rarely is necessary to remove the lymph nodes or to perform wide dissection of the parametrium. What is more important than either of these procedures, he wrote, is the removal of the ovaries on account of the frequent occurrence of implantation metastasis.

NATURE OF PAPILLARY CYSTADENOCARCINOMA OF THE OVARY

Papillary cystadenocarcinoma of the ovary tends to be primary in the ovary and usually starts by degeneration of a benign papillary cystadenoma. This lesion is characterized by a tendency to become bilateral to rupture early and to give rise to metastasis. The metastasis takes place by direct extension or by transplantation and not by the usual route through the lymphatic channel. Extensive peritoneal metastasis is seen at operation and at necropsy and metastatic growths are even felt as direct implantations at a time when the lymph nodes and sinuses are not involved.



Fig. 1. Papillary cystadenocarcinoma, primary of the ovary (Case 1).



Fig 2 Papillary cystadenocarcinoma secondary in the endometrium (Case 1)

MATERIAL STUDIED AND COMMENT

There were 520 cases of carcinoma of the body of the uterus and 616 cases of papillary cystadenocarcinoma of the ovaries in which operation was performed in The Mayo Clinic from 1913 to 1930. In 53 of these cases (Tables I, II, and III) lesions were found in ovaries and uterus. In the cases studied, the uterine lesion was confined to the body of the organ, had not penetrated the uterine wall, and was separated from the ovarian lesion by apparently healthy tissue. Cases in which the condition was extensive and the mode of occurrence was obviously by direct extension, and those cases in which the carcinoma was on the external surface of the uterus only, were not studied in detail, but are included in the tables.

Metastasis in any region of the human body may occur by the lymphatic system, the blood



Fig 3 Primary adenocarcinoma of the body of the uterus (Case 14)

stream, transplantation, or direct extension. It was obviously impossible to determine in most of the cases under consideration the mode by which metastasis occurred, because most of the cases were well advanced and the pelvis was filled with an extensive carcinomatous process. Furthermore serial section of the lymphatic structures, the blood vessels, and the fallopian tubes would have

TABLE I

Pathologist's Opinion of Nature of Secondary Growths in Ovary and Fallopian Tube in Five Cases in Which Primary Growth Was in the Uterus

Case	Ovary	Fallopian tube
1	Carcinoma	Carcinoma
2	Carcinoma	No growth
3*	Implants on inside of cysts	No growth
4	Degenerated carcinoma	Adenocarcinoma of fimbria
5	Carcinoma	Involvement of all tructus es

*The primary growth involved cervix also



Fig 4. Ad oc m d ry th n th fall p an
t b Th w d ry d oc m m ho th
ry (C 4)

been necessary. However several cases were studied with the purpose of determining the mode of metastasis. In the cases chosen for study of metastasis the disease was not advanced and lesions were not seen grossly except within the ovary and within the uterus and those lesions were separated by tissue of normal appearance.

In consideration of the possibility of metastasis by the lymphatic system it was found that the nodes of the parametrium were not involved and lymphatic structures were free of carcinomatous cells as far as could be determined by microscopic examination. The lymph vessel of the body of the uterus runs between the ovarian artery and the fallopian tube and then upward to the lumbar nodes. No outlet for the lymph vessels of the body of the uterus has been demonstrated until the lumbar nodes are reached and here also the ovarian lymph vessel drains. Transmission of material in either direction between the uterus and the ovaries through the lymph vessel would mean that the material takes a retrograde course. Although retrograde metastasis through the lymphatic channels a possibility observers do not feel that it occurs.

TABLE II

I th l g t s Op n s of \ t f Seco dary
G w th th Ut d Fall p T be
S t e C a e s i W h c h th P m r y G o th W s
n th O y

Case	B d f ru	Fall be
Car m		N gr b
7 Ca m tous m l		Car om
8 Car m		Ca f b b ed l
Ca m		N growth
C ma		N gr h
Car m		N th
Car m m		Ca b l al
Car m ma f h h		l l me b l l
Car m f d me		N growth
F p l r y f ocar m (m lan)		P l lary ar m
6 Ex i f m one d se oca f dus		C bul lous vol me t
Sec dary growth		N grow h
8 Car ma f endo exis (squamous-c il the b m gr ded in exis)		N gr b
Carcin ma		N gr with
F p l l r y de oc in ma f		Lavol me bil teral
Ca in ma f h de f teru		Car mator in l me of b se vo ed lso mudi and

*Ther wt in b th es f h urinary

The blood vessel of the myometrium in the group of cases of carcinoma of the body of the uterus were free of carcinomatous cell as well as the blood vessel of the tubes in a few cases that were studied in which the tubes were involved. In general the blood stream does not seem to be accepted as a means of metastasis of carcinoma.

The normal migration of the ovum from the ovary to the body of the uterus takes place through the fallopian tube. Sampson presented convincing evidence that migration of cell also takes place in the reverse direction (Figs 1 2 and 3) from the uterus to the ovary and he demonstrated endometrial and carcinomatous cell in the ovary and peritoneal cavity that had originated in the uterus. In several of my cases carcinomatous cell were found in the lumen of the fallopian tube and the blood vessels and lymphatic channel of

TABLE III

Pathologist's Opinion of Nature of Growths in Uterus, Ovaries, and Fallopian Tubes in Thirty-one Cases in Which the Situation of the Primary Growth Could Not Be Determined*

Case	Uterus	Ovary	Tube
2	Adenocarcinoma of body	Multilocular carcinomatous cystadenoma	No growth
23	Carcinoma of body and cervix	Intracystic carcinomatous cystadenoma	No growth
24	Carcinoma of body	Intracystic carcinomatous cyst	No growth
5	Carcinoma of body	Bilateral carcinomatous cystadenoma	No growth
6	Carcinoma of body involving whole of uterus	Bilateral intracystic papillary carcinomatous cystadenoma	No growth
7	Carcinomatous uterine polyps papillary cystadenoma	Intracystic and extracystic papillary carcinomatous cystadenoma	No growth
8	Carcinoma of body with involvement of cervix	Bilateral carcinomatous papillary cystadenoma	No growth
29	Advanced carcinoma of body	Intracystic and extracystic carcinomatous cystadenoma	Secondary carcinoma
30	Adenocarcinoma of uterus involving cervix	Adenocarcinoma	No growth
31	Extensive carcinoma of body	Carcinoma	No growth
32	Carcinoma of body	Intracystic carcinomatous papillary cystadenoma	No growth
33	Carcinoma of fundus	Bilateral carcinomatous cystadenoma	No growth
34	Carcinoma of body	Bilateral infected carcinomatous cystadenoma	No growth
35	Carcinomatous portions in endometrium	Carcinomatous papillary cystadenoma	No growth
36	Carcinomatous masses involving body of uterus	Bilateral intracystic and extracystic papillary carcinomatous cystadenoma	No growth
37	Early carcinoma of body	Intracystic and extracystic papillary carcinomatous cystadenoma	No growth
38	Carcinoma of body	Bilateral cystadenoma with region of carcinoma	Fimbriated end of right fallopian tube incorporated in carcinoma of right ovary
39	Adenocarcinoma of body	Multilocular intracystic adenocarcinoma	No growth
40	Adenocarcinoma involving entire fundus	Intracystic papillary carcinomatous cystadenoma	No growth
41	Carcinomatous polyp of body	Carcinoma	Carcinomatous portion in lumen
42	Carcinoma of fundus	Solid carcinomatous cystadenoma	No growth
43	Carcinoma of body	Bilateral carcinomatous cystadenoma	Involvement of right tube
44	Adenocarcinoma of body	Adenocarcinoma	No growth
45	Annular papillary carcinoma of body	Intracystic and extracystic carcinomatous papillary pseudomucinous cystadenoma solid carcinoma	No growth
46	Papillary carcinoma of body	Bilateral degenerating papillary carcinoma	No growth
47	Adenocarcinoma of fundus	Bilateral carcinomatous papillary cystadenoma	No growth
48	Adenocarcinoma of body	Bilateral adenocarcinoma	No growth
49	Adenocarcinoma of body	Bilateral cyst containing carcinoma	No growth
50	Diffuse adenocarcinoma of body	Intracystic papillary adenocarcinoma	No growth
51	Diffuse papillary adenocarcinoma also adenocarcinomatous polyp of body	Multilocular solid intracystic papillary adenocarcinoma	No growth
52	Papillary adenocarcinoma of body	Adenocarcinoma	No growth

*In one case which is not noted in any of the tables there was a carcinoma of the body of the uterus which apparently was independent of the carcinomatous cystadenoma of the ovary.

the tube were apparently normal. Clark and Norris referred to 2 cases in a series of 115 in which carcinomatous cells were found in the lumen of the tube. They expressed the belief that transtubal dissemination occurs in many cases of combined ovarian and uterine carcinoma. In another report of 101 cases of carcinoma of the fundus Norris reported 8 cases in which the ovaries were involved and Cameron reported 9 cases of carcinoma of the ovary secondary to carcinoma of the uterus in a series of 31 cases. It was not possible in every case of my study to find in the tube proof that the carcinomatous tissue had passed through but in 15 of the 53 cases secondary involvement of the tube was present. It is possible that dislodged carcinomatous cells may pass through the lumen and not become attached until they reach the site of the future secondary growth.

It was likewise difficult to decide in these cases which was the primary and which was the secondary lesion. The size of the tumor was not conclusive evidence for a secondary growth may be larger than a primary growth. The symptoms of carcinoma in both organs are similar. Carcinomata of the body of the uterus probably give rise to symptoms earlier than do lesions in the ovary. Metrorrhagia may occur early in the presence of carcinoma of the uterus whereas carcinoma of the ovary often does not produce symptoms until a palpable tumor or pain is noticed. In this study the chronologic appearance of symptoms was of little value. The study of the cell gave more information. MacCarty has stated that study of the fresh tissue cell may give information regarding the origin of the carcinoma. The microscopic study made of fresh tissue in this group of 53 cases revealed 5 cases of primary uterine carcinoma with metastasis to the ovary (Table I), 16 cases in which the lesion was primary in the ovary and secondary in the uterus (Table II), 31 cases in which it was impossible to determine the situation of the primary lesion (Table III)

and 1 case in which there was a carcinoma in the uterus and another in the ovary each independent carcinomata (see footnote on Table III).

SUMMARY

In a series of 520 cases of adenocarcinoma of the body of the uterus there was associated carcinoma of the ovary in 11.9 per cent and in 616 cases of papillary cystadenocarcinoma of the ovary there was associated carcinoma of the body of the uterus in 8.6 per cent. The fallopian tube should be considered as one of the means through which transplantation take place. Because of the similarity of the adenocarcinomatous cells in the embryologically similar tissues it is often difficult to determine which carcinoma is primary and which is secondary and whether or not there may originally have been two independent carcinomata. In cases of carcinoma of the ovaries the possibility of metastasis to the uterine endometrium even when there is no gross peritoneal evidence of extension of the malignant growth must be borne in mind. Because of this possibility hysterectomy at the time of removal of the ovaries must be seriously considered.

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3 5 PP
4 C T S C f th t ru Phil d lph
W B S d r Co 693 pp
5 Gr tes W P Gynec l gy 3d ed Philad lphi W
B Sa d r C 9 3 936 pp
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ABDOMINAL AND PELVIC FASCIAS WITH SURGICAL APPLICATIONS

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TO visit clinics and to read descriptions of various operative procedures, one naturally must resort to a textbook on anatomy to be able to visualize those structures which are referred to so freely and apparently so understandingly by the various authors and operators, but to one's bewilderment, even the best American and English textbooks do not satisfactorily discuss this anatomy which we are anxious to understand more intelligently.

Various German authors Halban, Veit, Tandler, Martin, and, in America, Gallaudet, agree that there are two systems of fascias in the abdominal and pelvic regions, the one, a thick fibrous sheet which covers the voluntary muscles, such as the diaphragm, the oblique muscles, the transversalis, the obturator internus, the ileo-psoas, and the pyramiformis.

Various daughter splits may be given off from the parent fascia, but being derived from fascia covering voluntary muscles, the daughter fascia will surround voluntary muscles and not an involuntary muscle, such as the vaginal tube which is mistakenly supposed to be surrounded by a definite fascial layer, such as surrounds the deep transverse perineal muscle. Involuntary muscles and abdominal organs are surrounded by a structure which resembles the superficial fascia of the abdomen more than it does the deep fascia of the abdomen. This layer is referred to by the German authors as the connective tissue fascia (*Bundegewebe*) and by Gallaudet as the "Subperitoneal fibro-areolar layer (Fig 1, S P)".

The abdominal wall may be visualized as consisting of a cylindrical wall of voluntary muscle, the oblique and transversalis muscles. The muscle layer is surrounded by a distinct sheath of fibrous tissue. The superficial layer of this fibrous sheath is referred to as the *deep fascia of the abdomen* (Fig 1, D F) and this structure together with the tendon of the

external oblique muscle is the layer upon which our attention is directed in a repair of the abdominal wall. The deeper layer (Fig 1, T F) is referred to as the *transversalis fascia* and is too often disregarded in a repair of the abdominal wall, except in the upper quadrants, where it becomes more conspicuous due to the hypertrophied deep layer of the internal oblique muscle tendon which fuses with the tendon of the transversalis muscle and with the transversalis fascia. It thereby becomes more conspicuous and less likely to be ignored, particularly if the external oblique tendon is attenuated. Superficial to the so called deep fascia of the abdominal wall is the superficial fascia (Fig 1, S F), and deep to the transversalis fascia is a layer not unlike the superficial fascial layer, "the subperitoneal fibro-areolar layer" (Fig 1, S P). Superficial to the superficial fascia is the skin and deep to the subperitoneal fibro-areolar layer is the peritoneum. It can then be seen that the central layers of the abdominal wall are the voluntary muscles which are covered superficially and deeply by a definite fascial layer. Superficial to the superficial sheath (Fig 1, S F) and deep to the deep sheath (Fig 1, S P) is a layer of fibro-areolar tissue which transmits the nerve and blood supply of the abdominal wall.

Superficial and deep to these fibro-areolar layers are the skin and the peritoneum, respectively. In general, the skin and the peritoneum, the subcutaneous and the subperitoneal layers, the deep and transversalis fascias, correspond except that the cutaneous and subcutaneous layers are of a coarser texture than the corresponding peritoneal and subperitoneal layers, which may be due to external influences.

The subperitoneal (Fig 1, S P) and subcutaneous (Fig 1, S F) layers consist of two portions, a fibrous and an areolar layer in which there are varying quantities of adipose tissue. In the subcutaneous region the fatty

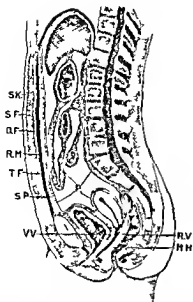


Fig. D. g. mm. t. sagittal ect. f. th. bd. m. l. w. d. th. p. l. T. sh. w. th. lay. rs. f. th. bd. m. l. w. d. th. p. l. bp. nt. l. t. ss. rr. dung. th. bd. m. l. w. d. th. p. l. g. d. p. f. scia. R. M. tu. mu. l. T. F. t. rs. ls. f. sc. S. P. bp. nt. l. f. b. o. l. ly. M. H. ham. h. d. l. mes. t. d. f. gna. l. l. es. gi. l. d. R. V. ect. es. l.

layer 1 referred to as Camper's layer while the deeper fibrous layer is called Scarpa's layer. We will first consider the voluntary fascial layer which ensheathes the transversalis muscle medially (Fig. 1 *TF*) and secondly the subperitoneal fibro-areolar layer (Fig. 1 *SP*) in which the various abdominal and pelvic organs and structures develop.

VOLUNTARY FASCIAL LAYER

The transversalis fascia is the term applied to the deep layer of fascia which ensheathes the voluntary muscles on the medial surface of the abdominal wall (Fig. 1 *TF*). Not only is it applied to that layer which covers the transversalis muscle medially but also the abdominal fascial layer which surrounds the diaphragm. It can be traced distally as the sheath of the ileo-psoas muscle to the false pelvis (Fig. 2 *IF*) it enters into the true pelvis where it covers the inner surface of the body of the pubis (Fig. 2 *P*) and the obturator internus muscle (Fig. 2 *OIF*). In the con-

cavity of the sacrum it ensheathes the pyriformis muscle and at the arch of the pubis (Fig. 2 *AC*) it continues distally as the fascia covering the adductor muscles of the thigh.

From the parent fascia daughter layers are given off which ensheath the voluntary muscles. Such a splitting occurs in the pubic arch (Fig. 2 *AC*) as the fascia covering the obturator internus muscle proceeds to become the fascia of the adductor group of muscles in the thigh. A double split is given off at each ramus which is directed medially and fuses with the opposite splits to form the so called superficial and deep layers of the triangular ligament (Fig. 2 *TL*) while the voluntary muscle contained therein is called the deep perineal or triangularis muscle.

Along a line running from the posterolateral surface of the body of the pubis to the spine of the ischium (Fig. 2 *VL*) the obturator portion of the transversalis fascia sends two daughter splits medially and distally to ensheath the levator ani muscle. The muscle arises from the posterior surface of the pubis and from the angle between the two daughter splits at their junction with the obturator fascia. The insertion of the levator is into a median raphe which extends from the tip of the coccyx to the anus (Fig. 2 *CT*). It also surrounds the anus laterally and sends a small strand of fiber into the perineal body. As the pubococcygeal portion passes lateral to the vagina and the urethra it sends few small muscular strands into the lateral wall of the vagina and a small bundle medially between the vagina and the urethra. Just as the fibers posterior to the anus and posterior to the vagina act as voluntary constrictors of these structures so the transverse fibers between the urethra and the vagina may aid as voluntary constrictors of the urethra.

The daughter split of fascia which ensheathes the levator ani on its proximal or visceral surface (Fig. 3 *VL*) is referred to as the visceral or deep layer of the levator fascial sheath while the split which encloses the levator ani on its inferior or superficial surface (Fig. 3 *PL*) is referred to as the parietal or superficial layer of the levator sheath. The coccygeus muscle arising from the spine of the ischium inserts into the lateral border of

the coccyx and does not act as a levator muscle other than through its action on the coccyx. The pyriformis muscle aids the coccygeus in completing the muscular outlet of the true pelvis posterior to the levator ani muscle.

In the perineal body, anterior to the anus, unlike on the lateral and posterior areas of the anus, the muscular and fascial layers are not distinct and thereby not readily identified, for there is a blending of the fascial layers with transverse muscular strands of the levator muscle, together with the layers of the triangular ligament and the deep perineal muscle, contained therein.

INVOLUNTARY FASCIAL LAYER

The involuntary fascial layer (Fig 1, *SP*), being subperitoneal and deep to the fascia covering the voluntary abdominal muscles, corresponds to the subcutaneous fibro-areolar layer (Fig 1, *SF*), which lies superficial to the fascia covering the voluntary abdominal muscles. It is composed of a fibrous and an areolar layer which contains in its meshes varying quantities of adipose tissue. The superficial organs such as the sweat glands, the sebaceous glands, the hair follicles, and the breast, originating from the epithelial layers of the true skin, penetrate the subcutaneous tissue and mature. In addition, the subcutaneous tissue serves as a path for the passage of arteries, veins, nerves, and lymphatics of the superficial abdominal wall, and its contents. Just as the organs related to the superficial structures develop in the subcutaneous fibro-areolar layer, so the organs and structures related to the abdominal and pelvic regions develop in the corresponding subperitoneal fibro-areolar layer. Superficially, the occlusion of the duct of a sebaceous gland may cause the gland to enlarge and distort the surface of the skin, but in doing so the subcutaneous tissue becomes so attenuated that the gland appears to be covered only by the skin. In the same manner the organs which develop in the subperitoneal fibro-areolar layer increase in size and may force the peritoneum before them and bulge into the peritoneal cavity. In the case of the intestines, they grow into the peritoneal cavity so com-

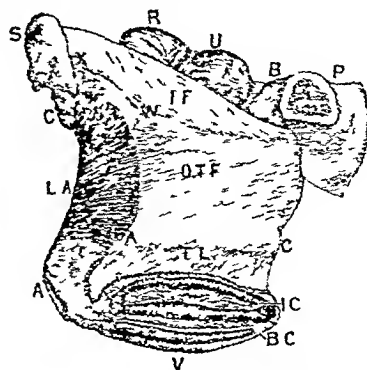
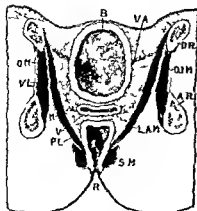


Fig 2 To show continuation of transversalis fascia into the true pelvis. Specimen was obtained after removing all of the ileum, and the ischium and the distal portion of the pubic bones without disturbing the transversalis fascia, on the medial surface of the pelvic bones. *S*, Sacrum, *C*, coccyx, *LA*, levator ani, *A*, anus, *R*, rectum, *U*, uterus, *B*, bladder, *P*, body of pubic bone, *IF*, iliac fascia, *OTF*, obturator internus fascia, *TL*, triangular ligament, *IC*, ischio cavernosus muscle, *BC*, bulbocavernosus muscle, *V*, vaginal introitus.

pletely that they can be said to be pedunculated and apparently lose their connection with the subperitoneal fibro-areolar layer except through their mesentery and the very thin fibro-areolar layer which surrounds them. Such organs as the liver, spleen, intestines, uterus, and fallopian tubes, which are considered to be intraperitoneal, by their growth and bulging into the peritoneal cavity, lose most of their fibro-areolar covering, while those structures such as the kidney, ureter, the distal portion of the bladder, the vagina and the rectum, which do not bulge intraperitoneally, are covered by a very definite layer of fibro-areolar tissue. This readily recognizable layer in the region of the kidney resembles Camper's layer of the subcutaneous tissue and is often referred to as the fatty capsule of the kidney. Peripheral to the fatty layer there is a more concentrated layer which resembles Scarpa's layer of the subcutaneous tissue.

That the intestines are still covered by this layer of tissue, even though very thin, is evident by the tendency to fatty deposits in it, such as the appendices epiploicae. That the uterus itself, is covered by this layer is more evident during pregnancy, when there is a hypertrophy of this tissue. It is evidenced by our ability to separate the peritoneum from



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t i a s i n h h t h e r y i n g a t t i f i t y d
p o t B t w the g n n d t h b l a d d b t w
th g u n a d t h e c t m t h r l t t l f t r y d e p t
d r y l i t t l f i b r o u t c e q t l y t h t c
e c t i n g t h b l d d t t h a g n d l t h t m
t o t h g u n a i s m l y c o l t O V O b t t
m m b l l s c a l l y f l t f s c P L
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the lower half of the uterus as is practiced in the low flap cesarean section. Summarizing one notes that those organs which are considered to be intraperitoneal due to their growth into the peritoneal cavity are covered by a very thin layer of fibro areolar tissue while the extraperitoneal structures and organs are covered by a more definite layer of fibro areolar tissue in which there is a greater deposit of adipose tissue accompanying blood vessels there is a concentration of the fibrous portion which suggests a definite ligamentous structure. On those areas which are compressed by expansion of the organ or structure there is an increased deposit of adipose tissue in the areolar portion.

The intraperitoneal and extraperitoneal structures of interest gynecologically are the bladder, rectum, vagina and uterus.

Bladder. Practically the entire collapsed bladder (Fig 3 B) except its abdominal surface is surrounded by a thick layer of fibro

areolar tissue which as in the region of the kidney can be readily separated from the bladder except in the regions of the superior middle and inferior vesical vessels. On the abdominal surface of the bladder the fibro areolar layer is so thin that the peritoneum appears to be intimately connected to the bladder and for this reason does not permit complete extraperitoneal mobilization of the organ. The attenuation of the fibro areolar layer subperitoneally must be remembered when performing the extraperitoneal cesarean section as is described by Latzko. To the concentration of the fibrous portion around the vessels supplying the bladder the term true ligaments of the bladder has been applied.

On the vaginal surface of the bladder (Fig 1 I I) there is a thinning of the fibro areolar layer but there is no fusion to the corresponding surface of the vagina because it likewise is covered by a similar thin layer of fibro areolar tissue. These opposing layers are held together by a very loose areolar tissue which because of its spider like texture can be readily broken and give the appearance of a vesicovaginal space. A similar condition exists between the posterior wall of the vagina (Fig 1 R I) and the anterior surface of the rectum to which the term rectovaginal areolar area has been applied.

Rectum. The rectum being extraperitoneal is surrounded by a very heavy fibro areolar layer in which there is an extra deposit of fatty tissue. The inferior hæmorrhoidal artery, being a branch of the internal pudendal artery supplies that portion of the rectum distal to the levator ani muscle (Fig 3 L A M) and consequently does not lie in the subperitoneal tissue. The superior hæmorrhoidal and the middle hæmorrhoidal vessels traverse the fibro areolar layer and are surrounded by a denser fibro areolar tissue. The many ramifications of the superior hæmorrhoidal artery together with its thickened fibrous surroundings form very definite supporting strands of fibrous and vascular tissue which prevent the prolapse of the rectal wall but not of the mucous membrane.

Müllerian ducts. The müllerian ducts (Fig 4) being retroperitoneal and covered by

fibro-areolar tissue, are located posteriorly and lateral to the midline. They receive their blood supply independently. Each duct can be likened to a loop of intestine with its nerve and blood supply entering it at a fixed border. There is the usual thickening of the fibro-areolar layer around the vascular supply which terminates in the lateral wall of the entire tube, from its proximal to its distal extremity. A similar structure attached to an intraperitoneal organ is called a mesentery and to have an accurate comprehension of this structure and yet to differentiate it from a true mesentery, the term mesenteroid may be applied. As the embryo matures, the distal portion of the two ducts approach each other and fuse at the border opposite the mesenteroid attachment. Further development results in the absorption of the intervening septum, with the formation of a single cavity. The proximal portion of the single cavity becomes the uterus and the distal portion the vagina, while the intervening portion becomes the cervix. The uterus and the vagina lie in the center of a sling (Fig 5), the lateral support being the individual mesenteroid to that half of the reproductive apparatus. As the uterus and the fallopian tube develop, they bulge intraperitoneally and draw their blood supply with them, this thereby angulates the uterine artery but does not change the direction of the vaginal arteries.

Pushing the peritoneum before it in the midline, together with the fixation of the ovarian extremity of the fallopian tube, causes the formation of the so called lateral or broad ligaments of the uterus (Fig 5, *BLU*). The leaves of the broad ligaments can be separated from each other due to the presence of a small amount of fibro-areolar tissue enclosed between them. The adult uterus, being intraperitoneal, appears to be devoid of an extraperitoneal fibro-areolar layer, but during pregnancy this layer hypertrophies, particularly in its lower half, and permits the performance of the so called low flap cesarean section, in which the peritoneum of the lower half of the anterior surface of the uterus is mobilized before the uterus is incised.

Vagina The vagina, remaining extraperitoneal, is covered by a layer of fibro-areolar

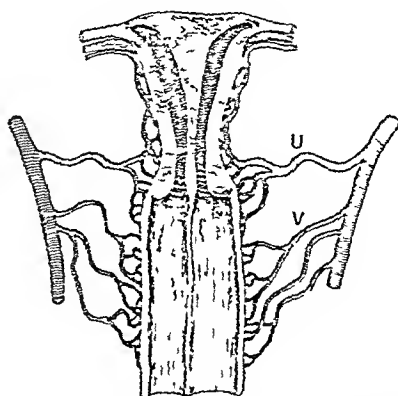


Fig 4 Septate uterus and vagina with blood supply to each individual portion. To show reproductive apparatus in center or sling partly formed by blood vessels *U*, Uterine artery and *V*, vaginal arteries

tissue which is most pronounced along its lateral border (Fig 5 *BLV*) where the vaginal portion of the uterine and the vaginal arteries traverse the space between the lateral border of the vagina and the superior layer of the levator fascia (Fig 3, *M*). There is merely a spiderweb-like attachment which unites the vagina to the bladder anteriorly and to the rectum posteriorly. It is possible readily to separate the vagina from the bladder and from the rectum by incising the involuntary muscular wall of the vaginal tube and by breaking the fine areolar connection which binds the vagina to the vaginal surface of the bladder or to the vaginal surface of the rectum.

Many operators ignore the presence of a very delicate areolar connection between the rectum and the vagina, and between the bladder and the vagina. They refer to this area as the rectovaginal and the vesicovaginal space because of the ease with which this area is entered during plastic operations (Fig 1, *VV* and *RV*).

The rectovaginal area unlike the vesicovaginal area is divided into an upper four-fifths and a lower one-fifth by a distinct horizontal mesenteroid (Fig 1, *MH*). This is formed by the terminal portion of the middle hæmorrhoidal arteries and veins together with their fibrous surrounding, as they pass from the rectum to the posterior surface of the vagina, about 2 centimeters from the triangular ligament. The ligamentous appearance of

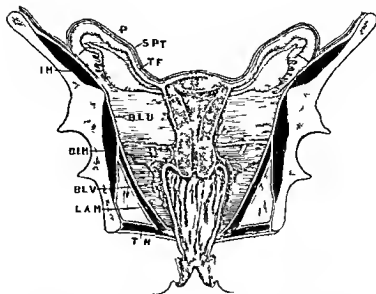


Fig 5 D g m m t l t l g t l c t f t r u d f l p l T h w
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 t w h h f r m d f t l t r a l p p r t f t h t r u d t h g n a P
 P n t m S P T u b p r i a l f i b o f t i s T F f l l p i a t b I M
 l i m c l O I M o b t i a n t m s m s c l B L V b d l g m t f
 g u n (i t l m t d f g n a) L A M l t m s c l d T M
 t n g u l n m s c l

this structure has caused it to be called the pillar of the rectum. It has been utilized in operations for rectocele whereby the vaginal termination of the mesenteroid is divided and reattached on the posterior wall of the vagina proximal to its original termination.

THE LATERAL OR BROAD LIGAMENTS

Stretching from the fallopian tubes proximally to the triangular ligament distally lateral to the uterus and the vagina there is a distinct plane through which the uterine and vaginal vessels pass to their termination (Fig 5). The vessels are surrounded by a thickening of the subperitoneal fibro areolar tissue which is much heavier extraperitoneally than it is intraperitoneally. That intraperitoneal portion which stretches from the uterus to the lateral pelvic wall has been called the lateral or broad ligament of the uterus (Fig 5 *BLU*).

While the extraperitoneal portion which is less accessible seems to be less familiar and

consequently unnamed (Fig 5 *BLV*) the proximal portion of the extraperitoneal ligament or mesenteroid has been recognized and called the cardinal ligament. It must be understood that the cardinal ligament is not a solitary thickened band which stretches from the axis of the uterus to the lateral wall of the pelvis but as the proximal border of a trapezoid ligament or mesenteroid which extends from the axis of the uterus to the triangular ligament and stretches from the lateral border of the vagina to the superior layer of the levator of the levator fascia. Just as the broad ligament of the uterus prevents the passage of the hand from the uterovesical area to the uterorectal area so the lateral mesenteroid of the vagina (Fig 3 *M*) prevents the lateral passage of the finger from the vesicovaginal area to the rectovaginal area. It thereby prevents lateral mobilization of the vagina.

Comparing the lateral mesenteroid of the vagina (Fig 5 *BLI*) with the lateral ligament of the uterus (Fig 5 *BLU*) we find that the

latter is much wider and thinner than the former, which is narrower and thicker due to the vaginal plexus with its thickened fibro-areolar concentration. Poor fascial structure will cause a greater relaxation of the uterine portion than of the vaginal portion and thereby permit abnormal mobility of the uterus.

SHAPE OF THE UTERUS, CERVIX, AND VAGINA

The normal uterus and the vagina are flattened anteroposteriorly and elongated laterally. The anteroposterior flattening of the vagina is not due entirely to the pressure from the bladder anteriorly and the rectum posteriorly, but a very important contributing factor is the lateral attachment of its mesenteroid to the superior layer of the levator fascia.

The uterus being likewise suspended in the center of a sling formed by the broad ligaments, will conform to stress and strain and become slightly wider in its lateral dimension and correspondingly narrower in its anteroposterior dimension.

The cervix, which bulges freely into the vault of the vagina, has no lateral attachment and consequently assumes a cylindrical form.

RETROVERSION

The broad ligament of the uterus extends laterally as a relatively thin structure, but in the region of the union of the body of the uterus with the vaginal vault, where the uterine vessels traverse the lateral ligament, the structure of the broad ligament changes abruptly. This thickening is sometimes referred to as the cardinal ligament and is functionally the horizontal axis of the uterus. The lateral attachment of the uterine broad ligament, which is anterior to the long axis of the vagina, will throw the uterus anteriorly and thereby cause it to be further anteverted by abdominal pressure. Normally retroversion is prevented by the uterosacral muscles which are inserted distal to its axis, the cardinal ligaments, and also by the round ligaments or more properly the round muscles of the uterus, which are inserted proximal to its axis. To a lesser degree the uterovesical fold of peritoneum aids the round and uterosacral muscles in preventing that position.

In those cases in which there is a relaxation of the broad ligament, due either to a lateral attachment which is posterior to the normal attachment, or to an inherent loss of elasticity of the structures, intra-abdominal pressure may overcome the stress of the round and uterosacral muscles with the resulting retroversion of the uterus. For the repair of this condition we have been unable to transplant the lateral attachment of the broad ligament anteriorly, but Dr. Bissell has satisfactorily plicated the relaxed broad ligament in addition to the usual shortening procedures upon the round and uterosacral muscles. The writer is of the opinion that of all other operative procedures, the method described by Simpson for the cure of retroversion is perhaps the next satisfactory. However, it does not utilize the uterosacral muscles nor the lateral attachments of the uterus, but the round muscles are at least restored in their normal anatomical position.

PROLAPSE

The anatomical difference between the broad ligament of the uterus and the corresponding mesenteroid of the vagina would lead one to assume that a subnormal fascial tissue would cause a greater degree of relaxation in the thin uterine portion than in the thick, narrow, vaginal portion. Consequently a prolapse of the vagina is a relatively rare condition, while a prolapse of the uterus is comparatively frequent. The relaxation permits a retroversion which later descends, especially in those cases in which the cardinal ligament is attached to the vault of the vagina, rather than to the uterovaginal area. The normal attachment of the cardinal ligament to the uterovaginal area may account for the few cases of prolapse compared to the many cases of retroversion, but in a decade or more the cardinal ligament may relax sufficiently to permit a prolapse of the retroverted uterus.

For the early case of prolapse, operation. For retroversion together with a tightening of cardinal ligaments, as described by Alexandroff, may suffice.

HISTERECTOMY

Whenever the uterus and the cervix are removed and the vault of the vagina is closed

anteroposteriorly we note relatively frequently several months following the operative procedure that there is a slight relaxation of the newly constructed vault of the vagina. By approximating the medial attachments of the lateral ligaments in the midline which results from a lateral to lateral closure of the vault of the vagina a tensor sling will be formed which may be sufficient to prevent a prolapse of the vault of the vagina in those cases which are prone to a general fascial relaxation. Dr. Kennedy has utilized this mechanical principle in his report of a series of total hysterectomies. Other than for ease in peritonealization the attachment of the divided round muscles to the vault of the vagina is unnecessary because the lateral ligament of the vagina is a much more efficient support in preventing prolapse than the thin strand of round muscle.

In closing the vault of the vagina following a vaginal hysterectomy the approximation of the cardinal ligaments in the midline by a side to side closure will construct a deeper and more anatomical condition of the vagina than will result from procedures in which the cardinal ligaments are not approximated medially.

CYSTOCELE

That portion of the female reproductive system known as the vagina reserables the proximal portions of the genital system in that it is composed chiefly of involuntary muscular fibers together with fibrous tissue and like the proximal portion it is surrounded by a fibro areolar layer of tissue which is heaviest laterally where it aids in the formation of the vaginal mesenteroid while anteriorly and posteriorly the covering of fibro areolar tissue is almost negligible. To repair the so called cystocele which is probably a relaxation of the anterior wall of the vagina rather than a distinct laceration of it the repair is directed to the wall of the vagina which like in the gastrointestinal tract is composed of an inner circular and an outer longitudinal layer of involuntary muscular fibers and not to a definite fascial layer which lies peripheral to the muscular layer such as surrounds voluntary muscle. There is however the thin fibro areolar layer which surrounds involuntary

muscle but as such it can not effectively be used alone in the cure of cystocele.

RECTOCELE

The posterior wall of the vagina like the anterior wall is composed of a muscular wall which is surrounded by a thin layer of fibro areolar tissue. Posteriorly and laterally the rectum is surrounded by a heavy layer of fibro areolar tissue in which there is a large deposit of fat but anteriorly the fibro areolar layer is attenuated and corresponds to the covering on the posterior wall of the vagina. A delicate areolar tissue connects these opposing coverings but readily permits mobilization of the vagina from the rectum except at the junction of the upper four fifths with the lower one-fifth where there is the usual thickening around the vaginal branches of the middle hemorrhoidal vessels as they pass from the anterior surface of the rectum to the posterior surface of the vagina. The term hemorrhoidal mesenteroid of the vagina may be applied to this structure which is utilized by Ward in his operation for rectoepexy whereby the vaginal attachment of the mesenteroid is divided and transplanted proximal to its normal position.

PERINEORRHAPHY

No plastic repair is complete without including the perineal body which is composed of a voluntary muscle ensheathed by a very definite fascial layer. Not only does the deep triangular muscle together with the superficial and deep layers of the triangular ligament enter into the formation of the perineal body but there are also a few fibers from the levator ani which branch medially from the pubococcygeus together with the voluntary fascial covering them which aid in the formation of the conglomerate fibromuscular body. In a nullipara the pubococcygeus can be felt as a very definite pillar lateral to the vagina about 2 centimeters from the hymen but of this heavy bundle only a few fibers enter into the perineal body. To deliberately draw the pubococcygeus into the perineal body is unanatomical but it may improve the tone of the levator muscle. The tightening of the triangular ligament indirectly increases the tone of the lat

eral mesenteroid of the vagina by fixing its distal and medial extremity. Indirectly by repairing the anterior and posterior walls of the vagina and the lacerated or relaxed perineum, one not only improves the cystocele, the rectocele, or the relaxed perineum but the general tone of the pelvic outlet is increased, due to the tightening of the relaxed lateral mesenteroid of the vagina which extends from the lateral wall of the vagina to the superior layer of the levator fascia with which it is intimately connected.

CERVICAL REPAIR

To amputate the vaginal portion of the cervix should not be a dangerous procedure unless the amputation is so high as to expose the lateral attachment of the uterus and thereby damage one or more of its contained blood vessels. Sturmdorf in making a cervical cuff is certain that the mobilization is done anteriorly and posteriorly and not laterally, where danger is encountered.

In postpartum examinations of the cervix for a possible laceration, traction on the anterior and the posterior lips of the cervix will add to the already greatly distorted condition, because traction is made on the most elastic portion which is not efficiently transmitted to the body of the uterus. Traction laterally, however, will be more efficient due to the attachment of the broad ligament of the uterus.

POSTPARTUM HÆMORRHAGE

In all postpartum inspections for hæmorrhage, the sulcus of the vagina must not be overlooked, particularly since it is the least elastic portion of the vagina, and connects with the vaginal plexus contained in the lateral mesenteroid.

SUMMARY

1 Two systems of fascia are found in the abdominal and pelvic regions, the one a thick fibrous sheet which ensheathes voluntary muscle and the other a fibro-areolar layer which surrounds involuntary muscle and organs.

2 Organs and structures related to the skin develop in the subcutaneous layer, while organs and structures related to the abdominal and pelvic cavities develop in the subperitoneal layer.

3 Areas subjected to pressure by distention of the organ or structure are protected by an increased deposit of adipose tissue in the areolar layer.

4 Vessels traversing the fibro-areolar layer are surrounded by an increase of the fibrous tissue.

5 The mesenteroid to each muellennian duct forms the lateral support of the adult uterus and vagina.

6 The vagina like the rectum is a muscular tube composed of an inner circular and an outer longitudinal layer of involuntary muscular fibers. It is covered by fibro-areolar tissue.

7 A delicate areolar tissue connects the vagina to the bladder and to the rectum, except in the region of the hæmorrhoidal mesenteroid of the vagina.

8 The lateral ligament of the uterus is thinner and wider than the corresponding lateral ligament or mesenteroid of the vagina.

9 The lateral mesenteroid of the vagina is a trapezoid support formed by the vaginal portion of the uterine and the vaginal vessels as they traverse the fibro-areolar tissue lateral to the vagina.

10 The anteroposterior flattening of the uterus and the vagina is due to the lateral attachments.

11 The cylindrical shape of the cervix is due to the absence of a lateral attachment, and the preponderance of circular fibers.

12 The round and uterosacral ligaments are fibromuscular bundles in which the muscular tissue predominates.

13 Side-to-side closure of the vaginal vault following complete hysterectomy will increase the efficiency of the lateral attachments.

14 Plastic operations increase the general pelvic tone by increasing the tone of the lateral mesenteroid of the vagina.

15 The passage of the middle hæmorrhoidal vessels from the anterior surface of the rectum to the posterior wall of the vagina forms a distinct mesenteroid which divides the rectovaginal area into a proximal four-fifths and a lower one-fifth.

16 Postpartum cervical inspections are facilitated by traction which is placed laterally rather than anteriorly and posteriorly.

17 Sulcus tears are often serious due to a laceration of the vaginal plexus

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THE RETROPERITONEAL SYNDROME AND THE RELATION BETWEEN KIDNEY AND GASTRO-INTESTINAL REFLEXES

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EVERY surgeon, at least once in his career, has had this experience a patient comes to him with abdominal pain with vomiting, distention, arrest of feces, and gas. The diagnosis of intestinal occlusion or peritonitis seems to be beyond question, although the cause of the ileus or peritonitis is not very evident. Emergency operation seems to be necessary and when performed shows no liquid in the abdomen, the intestine dilated in some places and in others contracted and filiform, the appendix, stomach, duodenum, and pelvic organs apparently normal. Operation is performed and often the patient recovers, as if the operation had put a stop to the spasm or paralysis of the intestine.

We believe that some of these intestinal occlusions which are seemingly without cause, may be due to disease of the kidneys or to a pathological irritation of the posterior parietal peritoneum. One of us in 1897 noticed that an irritation of the parietal peritoneum may cause a series of reflexes which produce what is called "abdominal shock" or "peritonism." It, therefore, seemed probable to us that reflexes of the same kind might originate in the kidney or perirenal region.

The observation of numerous clinical cases confirmed this hypothesis. For some time past it has been known that a nephritic colic may manifest itself by abdominal and peritoneal phenomena intense enough to suggest ileus (Sternberg, Stewart, Quénu). In the literature several cases are reported in which the patients were operated upon for a suspected occlusion but operation did not show the cause of the distress. Some hours later, however, these patients passed small ureteral calculi and at the same time had bowel movements

We have also noticed in some patients with hydronephrosis that the condition was mani-

festated only by an acute abdominal syndrome without urinary symptoms. We reported some such cases in 1909 in Maire's thesis. Several authors have since discussed this subject, Samuels, Kern, and McGlannon having reported cases of hydronephrosis with gastro-intestinal symptoms.

One of us has collected a number of cases not only of kidney lithiasis and hydronephrosis but also of other surgical diseases of the kidney, such as tuberculosis, tumor, polycystic kidney, and pyonephrosis in which the conditions were manifested only by an abdominal syndrome with no urinary symptoms whatever.

Certain perirenal affections may also cause an acute abdominal syndrome. Extraparietal rupture of a hydronephrosis (von Saar), spontaneous perirenal hemorrhage (Grasman, Greco, etc.), and beginning perinephritic phlegmon (Tixier) often resemble intestinal occlusion or peritonitis. Frequently patients with these conditions have been operated upon on a diagnosis of acute appendicitis.

Following traumatism, an effusion of blood under the posterior parietal peritoneum (retroperitoneal effusion) sometimes causes a syndrome simulating peritonitis or intestinal occlusion. The following is a résumé of a characteristic case of that kind (Tixier).

A woman, aged 28 years, was in an automobile accident on December 12, 1927, at half past nine o'clock. Seen some hours later she showed signs of violent dorsolumbar contusion. Her abdomen was distended, she vomited twice. There was no sign of fracture of the spinal column or of the pelvis. Roentgenograms of the pelvis and of the lumbosacral spinal column were negative. The absence of lumbo-abdominal contracture and the pulse of 80 argued against the hypothesis of rupture of an abdominal organ. The next day the abdominal symptoms were worse, the patient was agitated, vomited bile, her pulse rose to 100, there was intense meteorism. A median laparotomy was made. The liver

17 Sulcus tears are often serious due to a laceration of the vaginal plexus

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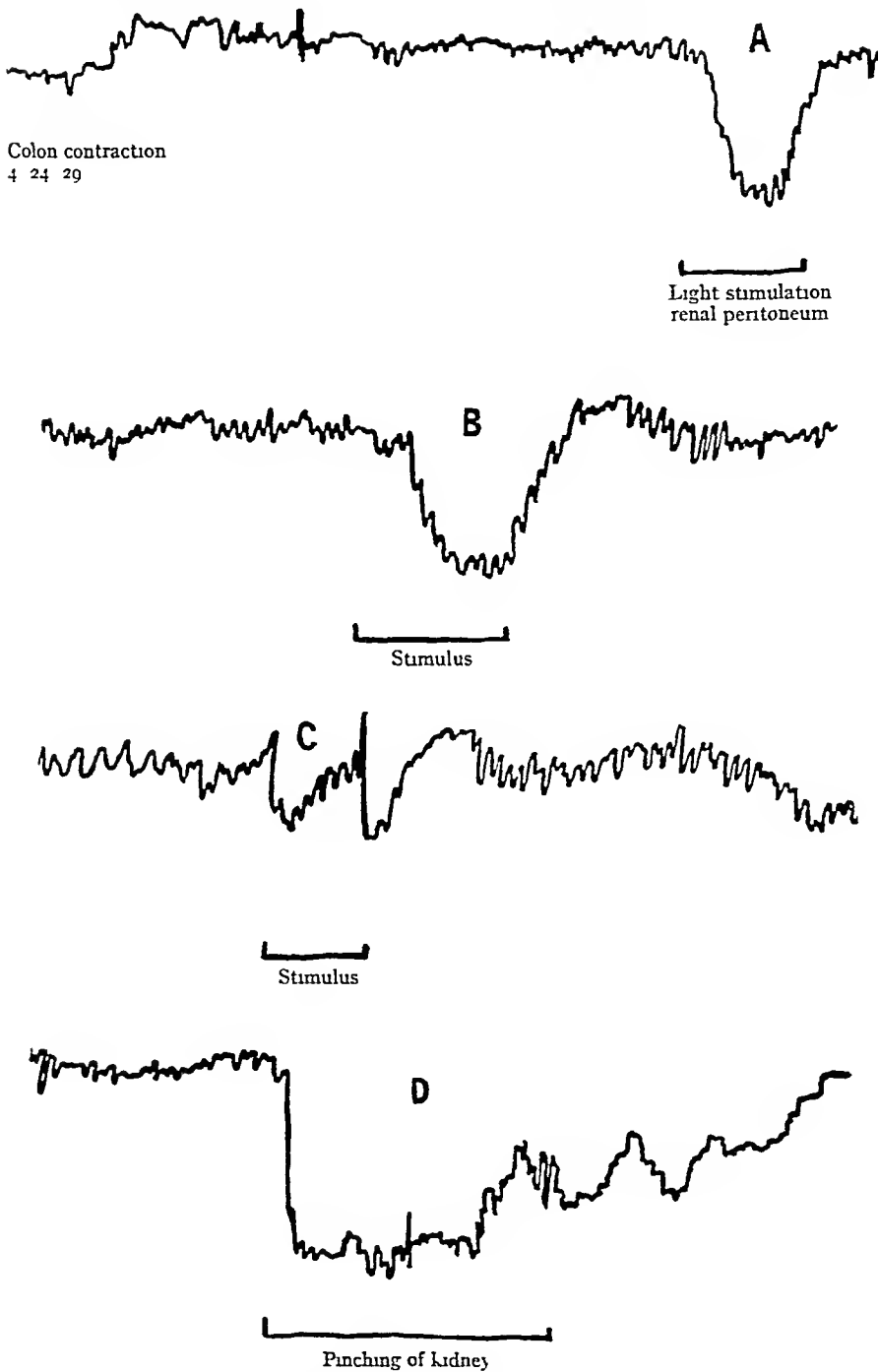


Fig 3 Tracing of the experiment shown in Figure 1 Each stimulus of the kidney region caused an inhibition of contractions of the colon

water placed in the stomach or intestine and connected with a Marey's kymograph (Figs 1 and 2) The tracings show the effect of renal stimuli on the motility of the intestine (Figs 3 and 4)

From the results of these experiments and from clinical observations we have been able to collect, we believe that we are safe in saying that there are kidney reflexes which affect the gastro-intestinal tract These reflexes may explain the curious abdominal syndromes sometimes found in the presence of kidney disease and would explain the pathogenesis of what we have called the retroperitoneal syndrome

PHYSIO-PATHOLOGICAL CONCEPTION OF THE RENO-DIGESTIVE REFLEXES

In the light of these anatomical and experimental data, theories may be evolved which may be found useful both in clinical and operative ways Let us take up successively the point of origin, and the center and centrifugal routes of these reflexes

Point of origin of the reflexes Stimulation of the pyelo-ureteral mucous membrane may be caused by a calculus, a blood clot, or a lump of pus

Stimulation of the pelvic nerve terminals by distention is brought about by congenital or calculous hydronephrosis, etc and occurs in the course of ureteral reflexes

In the presence of tuberculosis and tumors of the kidney, stimulation of the kidney substance by a pus focus or hæmorrhage under tension, is seen Reflex phenomena are not produced unless lesions of this kind are juxtacortical

In operations for floating kidney, particularly in nephropexy when the kidney is not entirely freed from adhesions, traction is brought about on the fibers of the renal plexus and indirectly on the solar plexus A perirenal hæmorrhage causes distention and laceration of these nerve fibers or the solar plexus itself may be affected

Traction on the prerenal peritoneum or its direct stimulation may be produced by perinephritic phlegmons or hæmatomata or by a hæmorrhage which suddenly distends a tumor or a polycystic kidney

Centers and points of reflection The solar plexus seems to be the usual center of reflection The phenomena seen clinically are very much like the syndromes of solar stimulation and paralysis described in 1853 by Claude Bernard and more recently studied by Laignel-Lavastine, Glockner Eimer and Jaeger, and others

There are perhaps reflexes with a shorter circuit which pass through the renal ganglia and the inferior mesenteric ganglion, but there are certainly reflexes which have a longer circuit arising in different segments of the cord According to Kappis and Gino Pieri, the twelfth dorsal and first dorsal lumbar segments correspond to the kidneys

An important question rises here the different irritations discussed are produced very frequently but the centers do not always respond to them Reno-digestive reflexes are not very frequently seen It seems to us that several conditions are necessary to make these reflexes evident

1 Necessity for summation of the irritations Experimentally an isolated renal stimulus does not always cause a response on the part of the digestive organs More constant more intense, and more durable effects are obtained by the summation of stimuli of different natures For instance, when cortical stimulation of the kidney has failed a combination of this stimulus with slight traction on the pedicle of the kidney or a distention of the pelvis and ureter is often effective

Clinically the same thing is true, and the renal affections which bring about digestive reflexes always do so by a complex mechanism Lithiasis is always associated with pelvic distention and traumatism of the mucous membrane of the pelvis by the calculus, hydronephrosis is associated with distention of the pelvis and traction on the prerenal peritoneum, in perirenal hæmorrhage the direct stimulus of the nerve plexus is associated with distention of the peritoneum by the blood effusion

2 Individual predisposition It is true that certain individuals are predisposed to reno-digestive reflexes While this predisposition has been attributed to vagosympathetic disequilibrium, this explanation is as yet only

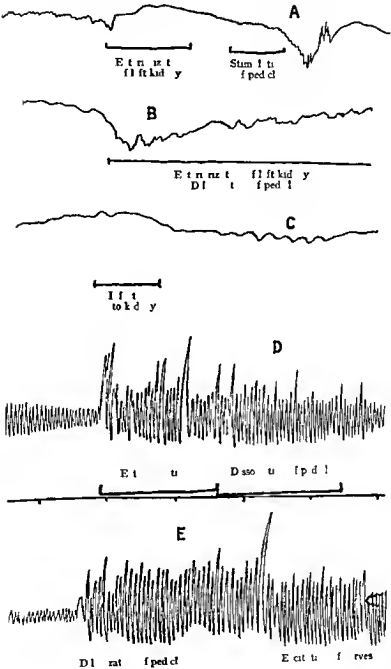


Fig 4. (A) The tracing of the fetal heart rate (FHR) obtained by the fetal heart rate (FHR) monitor. (B) The tracing of the fetal heart rate (FHR) obtained by the fetal heart rate (FHR) monitor. (C) The tracing of the fetal heart rate (FHR) obtained by the fetal heart rate (FHR) monitor. (D) The tracing of the fetal heart rate (FHR) obtained by the fetal heart rate (FHR) monitor. (E) The tracing of the fetal heart rate (FHR) obtained by the fetal heart rate (FHR) monitor.

PATHOLOGICAL STUDIES ON INJECTED VARICOSE VEINS¹

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THE injection treatment of varicose veins of the extremities is based upon the theory that the injected substance injures the vascular endothelium and causes the formation of a thrombus at the site of injury. The thrombus is believed to close the lumen of the vessel completely and when it becomes organized the vessel is entirely obliterated. In spite of a rather extensive literature upon the results of this method of treating varices, considerable uncertainty exists as to the exact nature and extent of the processes involved. The theory as usually stated does not explain the wide variations in the extent to which a vessel may be occluded by a single injection of a relatively mild solution. It does not explain the difference in the consistence of the occluding mass in various portions of the same injected veins, nor does it explain the partially successful treatments and the recurrences. The present investigation was undertaken with the hope that careful microscopic examination of treated veins might throw some light upon these rather perplexing questions.

Relatively few investigators have studied microscopically the changes that take place in artificially thrombosed varicose veins. Bazelis found that 24 hours after the injection of 1 cubic centimeter of mercury bismuthide, the endothelium was swollen and partially separated from the vessel wall. No clot or thrombus was present, no leucocytic infiltration had occurred. At 48 hours, proliferation of endothelial cells had occurred to such an extent that the lining membrane was unrecognizable. Fibrin had been deposited on the vessel wall. At 72 hours a clot had entirely obliterated the lumen. Regard studied the veins of dogs and rabbits 1 to 4 days after the injection of irritating fluids. He found that the vessel wall became oedematous. After the first day the endothelium was detached from the vessel wall. Fibrin then collected on the wall, and after the third day the lumen was obliterated by a thrombus. Sicard and Gaugier stated

that in the first stages the endothelium became hypertrophied. In the second stage fibrin collected over the whole injured area. Upon this basis a clot formed firmly adherent to the vessel wall.

Meisen found that 2 hours after the injection of a 40 per cent sodium salicylate solution into the median vein of a horse, the endothelium was greyish for a distance of 6 inches from the point of injection. Microscopically, red corpuscles were adherent to an apparently normal endothelium, occasionally in large masses, but mostly as a continuous lining gradually becoming palisade rows of erythrocytes. Twenty-four hours after the injection of a 30 per cent solution, a thrombus was formed so firmly adherent that force was needed to remove it with a knife. Microscopically, the large thrombus was nearly filling the lumen, and so closely attached to the vessel wall that no intima was to be seen. The adventitia showed an intense inflammatory reaction. With sodium citrate similar results were obtained, but the intravascular phenomena were less marked while the extravascular changes were more marked. Organization was noted on the sixth day.

Doerffel studied the ear veins of rabbits after injections of 30 per cent sodium chloride and 50 per cent grape sugar. He came to the conclusion that the successful action of these substances rested upon their stimulation of the intima into an extremely vigorous state of proliferation, within and upon the resulting meshwork of which a coagulation thrombus developed. Wolf injected the ear veins of rabbits with 1 per cent solutions of bichloride of mercury. He found that in the early stages the thrombus filling the lumen was clearly attached to the vessel wall at a point where the intima had become detached. The intima was found embedded in the thrombus thus guaranteeing firm fixation of the mass. The loosening of the intima did not occur throughout the whole vein, but only at separate points. At 2 days the above process had so

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a hypothesis. However in several patients recurrent accidents of different kinds have been noted for example in patients who have had nephritic colic associated with intestinal occlusion reflex ileus occurred after an operation on the kidney.

3 Sensitization of the nerve centers by an infection or intoxication. Experimentally an injection of pilocarpin greatly increases the intensity of the kidney reflexes to gastro intestinal tract and lowers the threshold of stimulation necessary to bring them about. Atropin and nicotine generally have the opposite effect. It is permissible to believe that a pre existing intoxication or infection acting on the solar plexus may change its reflex capacity and produce reflexes which without that would not have become manifest. We believe that uræmia even if slight frequently plays this part of sensitizer attacks of transitory uræmia in the course of kidney disease and after operation are now well known they may produce an intense effect on the nervous system. These hypotheses require further research.

Centrifugal routes of kidney reflexes to gastro intestinal tract. These reflexes may reach the cerebrospinal nervous system and produce pain which is localized by the patient in the skin zone which is the projection of these nerve (referred pain). Head carefully studied this pain projection on the wall of the abdomen in the course of the attacks of pain in kidney disease and established both their topography and their probable mechanism. This pain is associated with muscle contraction and may simulate an acute abdominal disturbance that is why we consider it in connection with renodigestive reflexes.

But the centrifugal route of the true reno gastro intestinal reflexes is the vegetative

nerves—the pneumogastric and particularly the sympathetic. The fact that these nerves are affected is easily verified in the presence of nephritic colic for example there are changes in the pulse blood pressure vasomotor disturbances etc (Pal Potain P. Franck Pailard).

From the point of view of their gastro intestinal effects these renal reflexes may be classified according to the organ in which they predominate.

1 *Reno gastric reflexes.* They are motor secretory and vasomotor. Sometimes they are phenomena of stimulation sometimes of inhibition. The pyloric sphincter is particularly sensitive to these stimuli. Carnot Satre among others have verified this experimentally.

2 *Reno intestinal reflexes.* Some reflexes are secretory and vasomotor others motor. Sometimes spasm is produced sometimes paralysis. The large intestine is particularly sensitive to these reflexes the rectum may be the site of similar phenomena particularly in the course of violent ureteral irritation (Loeper).

3 *Peritonism of renal origin.* These different reno intestinal reflexes may be associated with each other or combined with cardiac respiratory or vasomotor reflexes to cause a group of symptoms resembling those of peritonitis. The clinical picture is then made up of pain contracture of the wall distention vomiting arrest of feces and gas and rapid pulse without fever.

This in our opinion is the pathogenesis of the retroperitoneal syndrome.

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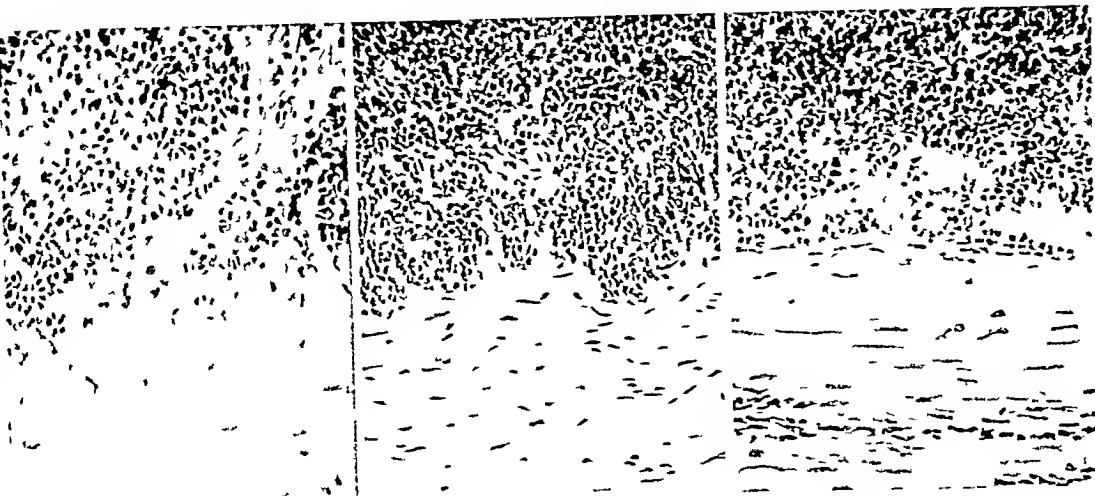


Fig 1

Fig 2

Fig 3

Fig 1 Severe intimal injury underlying laminated thrombus Twenty four hours after the injection of urethane

Fig 2 Severe intimal injury underlying simple clot

Fig 3 Loose clot overlying uninjured intima at a point 4 centimeters from the section shown in Figure 2

by the examination of segments from the varicose saphenous veins of six patients presenting themselves for treatment at the varicose vein clinic of the Minneapolis General Hospital. The specimens were removed 24 to 48 hours after the injection of urethane, or strong sugar or salt solutions. At the time of removal all of these were filled by a solid mass which varied somewhat in firmness in different portions of the single specimens. Immediately after removal accurate outline drawings were made to the exact size, and the specimens were fixed in 10 per cent formalin. With a sharp razor, 1 millimeter sections were taken at intervals of 2 to 4 millimeters through the whole length of the specimen. These blocks were numbered serially, sectioned, mounted, stained with hæmatoxylin and eosin, and studied serially.

Changes in the vessel wall Evidences of acute inflammation were found in all of these vessels. The adventitia invariably contained scattered infiltrations of polymorphonuclear and mononuclear leucocytes. In none was necrosis noted, and in none were the accumulations so dense as to suggest abscess formation. Rarely were more than 50 or 60 leucocytes seen under one high power field. The intensity of this reaction varied considerably

in various portions of the same vessel. In one section the changes might be marked, while a centimeter or two distant only an occasional leucocyte could be found. The reaction in the media was exactly similar. The leucocytes here were found scattered between the muscle fibers and much elongated in shape. Here also there was no reaction of such severity as to suggest even early abscess formation. As in the adventitia, there were frequently segments in which the media was almost free from leucocytes, while an adjacent or neighboring section showed fairly dense infiltration. Where the reaction was most intense, the muscle fibers frequently seemed stretched apart, as if by œdema. In general these inflammatory changes were most severe in the region of the vessel filled by deposition of thrombus, and were unusual in those portions where clot filled the lumen. However occasionally the most intense reaction was in a segment filled only by clot, where the intima was still intact. Likewise, the changes in the endothelium differed considerably in different portions of the same vessel. In each specimen the following variations in the state of the endothelium were noted: (1) In some portions where the deposition of thrombus was adherent the endothelium was unrecognizable (Fig 1)

extended that the whole intima was necrotic. No endothelium could be seen but at the margin of the lumen were large numbers of nuclear fragments. There were numerous clefts and depressions in the inner portion of the vessel wall and thrombus filled these spaces thus further immobilizing the occluding mass. At 5 to 7 days leucocytic infiltrations of the vessel wall were noted and increased numbers of polymorphonuclear leucocytes and lymphocytes were found in the thrombus. In the eighth and ninth day specimens organization was beginning. After a month organization was complete.

Schwarz and Ratschow found that 24 hours after the injection of a 50 or 60 per cent solution of calomel into the ear vein of a rabbit disintegration of the intima began and that a fine network of fibrin containing erythrocytes filled the lumen. Following this necrosis of the endothelial cells progressed and the fibrin network became denser. Evidences of exudative inflammation were seen in the vessel wall and these changes reached their maximum on the fourth day at which time a well stratified thrombus had developed. In 3 to 4 weeks the vessel could scarcely be recognized.

Binet and Verne studied the ear veins of rabbits after injection of 30 per cent solutions of sodium salicylate and found that the endothelial cells became hypertrophic assuming the form of undifferentiated mesenchyme. These elements then took part in organizing clot.

Kern and Angle caused thrombosis of the jugular vein in dogs by injection of 20 to 30 per cent sodium chloride solution in small doses (0.12 to 0.5 cubic centimeter). The specimens removed at 48 hours showed a very firm thrombus that was not easily dislodged. The vein wall was infiltrated by leucocytes and no endothelial cells were seen. After 1 week a firm thrombus occluded the distal segment. The thrombus was half red and half white and tapering. Plasma cells were beginning to grow into the thrombus. After 2 weeks the thrombus was about two thirds organized. In none of the 28 dogs used for the experiments did evidence of embolism or infarction of the lungs develop.

Howard Jackson and Mahon have recently described the histological findings in a larger

series of injected veins than had hitherto been reported. Thirteen separate veins were examined from 24 hours to 10 months after injection. Proliferation of endothelial cells into the thrombus was found at 72 hours and organization was distinct at 9 days. Complete organization and fibrosis had occurred at 9 months.

It is to be noted that in most of the observations the word clot and thrombus are used synonymously. A deposition thrombus is a solid mass formed in a vessel through which blood is flowing and is composed of the solid elements of the blood with or without fibrin. A moving stream of blood is essential to its formation. Coagulation thrombus however is formed from stagnant blood and may occur at any time that the conditions necessary to produce coagulation are present. It is nothing more than an ante-mortem clot. It is composed almost entirely of erythrocytes held together by an interlacing network of delicate strands of fibrin. Platelets are very inconspicuous and never occur in large masses. Leucocytes are present in no greater numbers than in the circulating blood and occur singly well distributed among the erythrocytes. The deposition thrombus has a characteristic microscopical appearance due to its manner of development. All deposition thrombi contain the separate solid elements of the blood in more or less distinct aggregations. Closely packed together are laminations composed of red cell masses, platelet masses, leucocytes and fibrin. These elements may vary considerably in the proportion they occupy of the whole. If leucocyte, platelets or fibrin predominate the structure is a white thrombus. If erythrocytes predominate the mass is called a red thrombus. Factors predisposing to thrombus formation are slowing of the blood stream, increased coagulability of the blood and roughening of the intima of the vessel. Since in a varicose vein the blood flows very slowly thrombosis should be obtained easily by injuring the intimal endothelium.

METHOD OF STUDY

The early changes produced in varicose veins by the injection treatment were studied

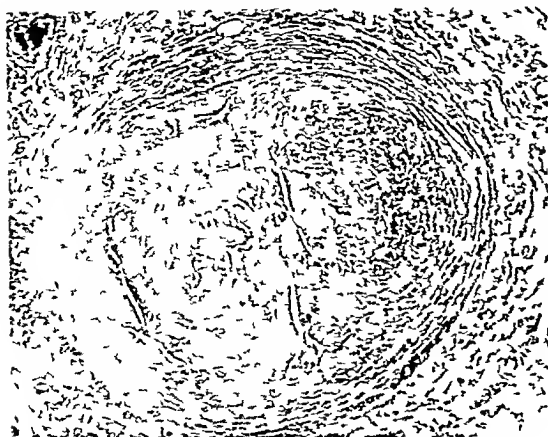
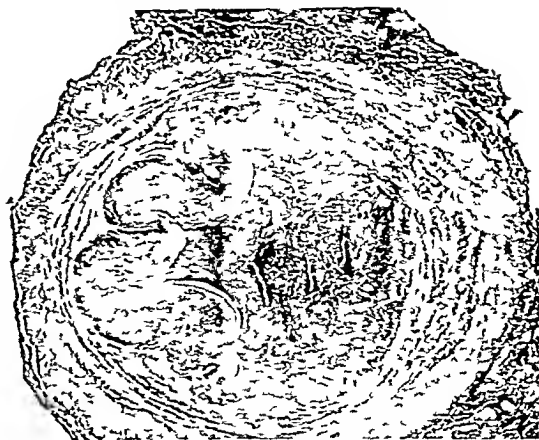


Fig 5 left Segment of a vein 605 days after artificial thrombosis. Fibrous tissue completely obliterates the lumen. The small spaces in the central portions represent dilated capillaries, and are probably remnants of those which took part in the process of organization. Note the preservation of the media.



this portion of the vessel obliteration has probably taken place by two separate processes. At the right the lumen is filled by hyalinized fibrous tissue containing traces of blood pigment. At the left there has been a tremendous hyperplasia of the intima, probably into an empty "cleft" or an area of softened blood clot. The thickened intima contains no blood pigment.

Fig 7 Specimen removed 760 days after injection. In

clotting substances, a clot will probably never extend into the deep veins of the leg or beyond the saphenofemoral junction so long as the circulation in these vessels is competent.

The essential facts concerning the development and structure of thrombi have been known for years, but they seem to have been overlooked by writers on the injection treatment of varicose veins. As early as 1899 Welch stated that the first stage is a white or accumulation thrombus, while the completed thrombus is a coagulum. In venous thromboses he noted that after the white thrombus has become occluding, the column of blood to the nearest branch or confluence is brought to a standstill and forms a red (coagulation) thrombus. Aschoff speaks of the primary, laminated portion as a deposition thrombus and states that this blends into and becomes continuous with the more extensive red portion or coagulation thrombus.

ORGANIZATION

The progress of organization was followed by the examination of segments of varicose veins removed from 44 additional patients treated in the varicose vein clinic of the Minneapolis General Hospital. The segments were removed 4 days to 760 days after

injection. The specimens used for this purpose were all obtained from the medial aspect of the thigh a few centimeters above the knee, and special effort was made to remove the segments only from veins which were approximately 1 centimeter in diameter at the time treatment was given. In these vessels organization was found to begin with penetrations of fibroblasts and capillaries into the thrombus on the fifth day after injection. On the forty-seventh day these proliferating

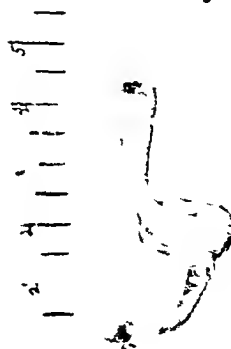


Fig 6 Segment of vein removed 760 days after injection. The narrower portions were completely occluded by hyalinized fibrous tissue. The dilated portion contained a semifluid chocolate colored mass of hemolyzed blood.

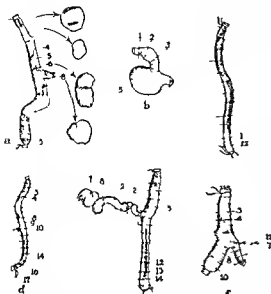


Fig 4. D g m h g h t r u l f t h o c t d n
m f t h a l p p l g e p e s t t h m b t h r s t p p h g p
l f t t h m b e d d i t d l e s p e s e t l l t
w h h b l o c k m e d f m o c p t d
l f t h p p m b e f t y p l l l

(2) Occasionally if there was only clot the endothelium was destroyed (Fig 2) (3) In other portions normal endothelium was found to underlie true thrombus. It would seem that to develop a deposition thrombus the endothelium must be injured but that thrombus does not necessarily develop upon all injured endothelium. It seems further that thrombus may at least extend itself over areas of normal endothelium.

Gross structure of the thrombus. The observations on the occluding mass were largely to determine whether the material consisted of clot or of deposition thrombus. By shading in the outline drawing of the vein the portions found in the cross sections to contain deposition thrombus a fairly accurate representation obtained of the whole mass which fills the vessel (Fig 4). These drawings necessarily do not represent the structure of the mass in detail since depth cannot be shown yet we are convinced that in all essentials the mass is as represented. In the

absence of true laminations as in the terminal portions of the thrombus masses of fibrin were considered as representing deposition thrombus. It has been observed repeatedly that the fibrin of a rapidly formed clot occurs in irregular filaments and delicate strands that form a mesh or network in which the erythrocytes are entangled.

As may be seen in the accompanying diagrams each vein had been occluded in exactly the same manner. The lumen in each specimen was completely filled by a solid mass of blood but of this mass only a portion consisted of deposition thrombus. The remainder was formed of simple blood clot. The deposition thrombus represented about one third of the occluding mass and only a very small portion of this completely filled the lumen. This finding is in entire accord with the theory of thrombus formation and with the modern coagulation theory.

MECHANISM OF OCCLUSION

It is well known that injured tissues and platelets liberate a substance tissue extract (Muller tissue fibrinogen) which is capable of precipitating fibrin from normal blood plasma. It is equally well known that in the formation of fibrin a substance (thrombin) is elaborated which is able to induce coagulation of normal plasma. Occlusion of the injected varicose vein begins with injury of the intima by the injected substance. Upon the injured area platelets are deposited and a deposition thrombus develops. As soon as the thrombus fills the lumen its growth ceases. At the junction of the thrombus and the now stagnant uncoagulated blood there will be present coagulating substances (tissue extract from the platelets in the thrombus) which will at once precipitate fibrin. This will cause an extension of the clot by the liberation of thrombin as thrombin is changed to fibrin. The extent of this clot or coagulation thrombus will be determined by the number and size of the tributaries and the rapidity of circulation through them. If tributary veins are numerous and their circulation active only a short segment of the vessel will be occluded. If the opposite conditions exist occlusion may be very extensive. Because of dilution of the

smooth muscle, no changes were found which could be ascribed with certainty to the injections. Even in the vessel removed 763 days after treatment, the identity of the media was clearly maintained (Figs 5 and 6). These findings contradict those of Bazelis who described almost complete destruction of muscular elements at 3 months.

Several different solutions were used to cause thrombosis in the veins studied. These were calrose (75 per cent invert sugar with 5 per cent saccharose), quinine sulphate 12 per cent with urethane 6 per cent, sodium chloride, 20 per cent, invert sugar, 35 per cent with sodium chloride, 15 per cent, sodium morrhuate, 10 per cent. There were no appreciable differences in the histological appearances caused by these different solutions. Following the injection of sodium morrhuate the inflammatory reaction seemed somewhat more intense than that caused by the other solutions and the rate of organization seemed slightly more rapid. However, too few specimens were studied after the use of sodium morrhuate to warrant definite conclusions.

MECHANISM OF RECURRENCE

In a number of specimens cleft like spaces were found between the intima and the blood mass filling the lumen. These usually occurred at levels which were occupied by clot, and in the later stages they were completely lined with endothelium. They frequently contained normal erythrocytes, indicating circulation of blood through them (Fig 8).

It has already been shown that simple clot forms the larger portion of the occluding mass in the treated vein. Inasmuch as retraction is a normal property of clot, it is probable that cleft formation results from retraction of the clotted portion of the occluding mass from portions of the intima insufficiently injured to cause its adherence. If retraction is so extensive that the resulting space between clot and vessel wall communicates between two tributary vessels opening into the principal lumen, the space at once becomes a blood filled sinus, and the vessel is again a part of the active circulatory system, with the potentiality of undergoing still further varicose dilatation. DeTakats and Quint have made note of similar find-

ings in veins removed after injections, and they point out the possibility of this being an underlying factor in the development of recurrences in the treated varicose vein. Howard, Jackson, and Mahon report the presence of such clefts in a large number of their specimens. They re-emphasize the importance of these spaces in producing recurrences of varicosities. Three of our specimens were from vessels which had developed recurrences after treatment. The lumen of each was found largely filled by fibrous tissue containing blood pigment. At the periphery were greatly dilated spaces containing fresh blood. Although greatly distended and rounded, the position of these sinuses was exactly similar to that of the clefts described (Fig 9). In none of these three specimens could the recurrence be ascribed to excessive dilatation of capillaries which had taken part in the process of organization.

CONCLUSIONS

Thrombus formation in varicose veins treated by injection of even "mild" solutions, depends upon an injury to the endothelial lining of the vessel. Deposition thrombus usually forms the smaller portion of the total occluding mass developed after treatment. The larger mass consists of simple clot.

Recurrence probably results from retraction of the clotted portion of the mass from the vessel wall between tributaries of the main channel, with re-establishment of circulation through the new channel.

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Fig 8 1 ft S t f l 4 d y ft j t Th
t l ma f cl tt d blood th h m t port f
wh h b d t gr with f fib bla t At th d
tw l g l ft l d with d th l m Th p l bly
es lt f m t t f th l t b f r ual has
b gu
l 9 S t f f m p t t h t d th

l l t d d th p m m i d
t l Th l p t f rm d f d fibro
t t t g bl d p t At th p ph ry
mb f l g es. Som f thes ta l t l
th h mb lt f j t d j p es
t m l

tissues had penetrated to all portions of the thrombus. From this time on there was progressive increase in collagenous fibers with absorption of the elements of the thrombus until 603 days later the space once occupied by thrombus had become a mass of extremely dense hyalinized fibrous tissue containing only traces of blood pigment. In the fibrous tissue were occasionally small dilated capillary spaces containing normal blood cells (Fig 5).

Organization advanced at a fairly even rate so that after some experience one could usually estimate to within the limits of a few days the age of the thrombus or clot. The speed and completeness of the reaction seemed to have no correlation with the thickness of the vessel wall or the state of its lumen or with the presence or absence of inflammatory changes in the adventitia. However the progress was not absolutely uniform as occasionally organization had progressed less in an older thrombus than in a younger. Thus the process was more complete in the eighty-ninth day specimen than in that 109 days old. It was often noted especially in specimens more than 100 days old that in certain portions of the vessel organization seemed to have come to a standstill with dense fibrous

tissue containing pigment at the periphery of the vessel lumen and semifluid hemolized blood remaining in the center. These areas in the gross specimens though greatly reduced in caliber were still considerably dilated beyond the diameters of other portions of the vessel and tended to give the vessel segment a beaded appearance (Fig 6). It seems probable that at the dilated portions the clot of blood was too soft to support the ingrowth of new tissue. Occasionally segments of vessels were found closed by the mechanism of intimal thickening. In these the lumen had become simply an irregular slit lined by endothelium and surrounded by a tremendously thickened and fibrous intima free from blood pigment. The appearances were exactly similar to those in disuse atrophy of a vessel and probably represent the fate of segments of the injected vessel in which the clot has undergone lysis and absorption without or with organization (Fig 7). The muscular coats even in the latest stages were surprisingly well preserved. Although all of the sections showed minor changes in the smooth muscle fiber such as hyaline degeneration and hyalinization and in a number of specimens there was an apparent increase of fibrous tissue between the layers of

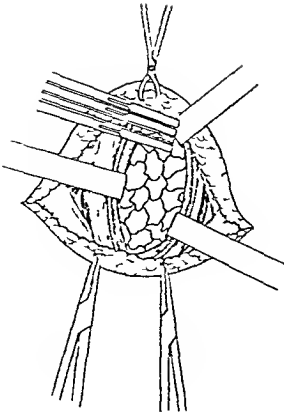


Fig 1

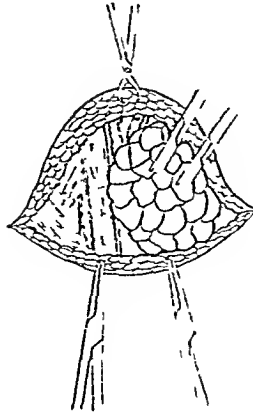


Fig 2

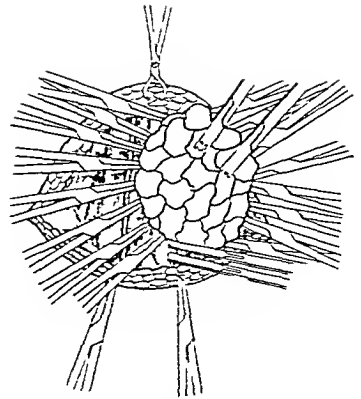


Fig 3

sufficient without dividing the strap muscles transversely. When in doubt always divide between forceps.

Step 4—Clamping of the superior thyroid artery. As a rule, with blunt dissection the vessels readily come into view. They are triple clamped with Kocher forceps and divided between the distal pairs, double clamps being left on the proximal end. From now on Kocher forceps should not be used but smaller Crile forceps.

Step 5—Delivery of the lobe. The upper pole should be delivered first and this is done by seizing the gland with Lahey forceps. A moderately enlarged lobe will generally roll out without difficulty, but, if there is a substernal projection, such is not the case. Never attempt to deliver the lower pole with the fingers unless all other methods fail. If the lower pole does not deliver readily, leave it alone until the upper pole has been liberated. This liberation of the upper pole allows the entire lobe of the gland to be dislocated upward and makes for easy delivery of the lower pole.

The recurrent nerve can be stretched or torn by digital delivery of the lower pole, and it would appear that this must be considered as one of the causes of recurrent nerve injury.

When the lobe is delivered, with gauze gently wipe backward the retroglandular fascia and grasp vessels with Crile forceps all around the lobe, being careful to keep forceps level and never to point them downward and inward and never to take large bites. Do not remove or pinch off any lobules of fat lest it be a parathyroid gland.

Step 6—Amputation of the lobe. The aim should be to have a trough shaped piece of gland remain, but the amount to be left can be judged only by the type of case, the type of gland, and a great deal of experience in thyroid surgery.

The excision of the lobe is best done by cutting it on one side and then on the other liberating some tissue at the upper pole and then some at the lower pole. Take time doing this and allow the assistant plenty of time to secure uncut vessels and bleeding points. At this stage, a reckless, panicky assistant can do a great deal of harm. He should hold a sponge in one hand and a pair of forceps in the other and follow along after the surgeon's knife, grasping bleeding vessels if he sees the bleeding point clearly. If he does not see the bleeding point, he should never guess at its location but should place a sponge of gauze over the area and then gradually sneak it off and get the bleeding point when it appears as the pressure is released. Blind grabbing of vessels by an assistant gives more surgeons "operative heart failure" than anything else. The assistant should also know the location of the trachea by feeling it with his fingers.

Step 7—Ligation of the vessels. The superior pole should be doubly ligated and all other points singly, either with No. 1 or No. 2 catgut, but the latter size is best for the superior vessel. When all the vessels have been tied and all bleeding points stopped, the surface of the gland may be folded on itself by two or three interrupted sutures, the outer capsule being joined to the tracheal side. However, this procedure is not always necessary.

Step 8—Closure. While the other lobe is being removed, the cavity left by removal of the first is packed with a teased out gauze fluff. When the second lobe has been removed the reconstruction work begins and the question of drainage is one to be settled. Drainage is rarely necessary with this technique, unless in the case of large substernal adenomata, but the advice again is, when in doubt, drain, but always be careful how you

CLINICAL SURGERY

FROM THE TORONTO GENERAL HOSPITAL

THYROIDECTOMY

R. V. B. SHIFFER, M.B. (T.) F.R.C.S. (C.) F.A.C.S. Toronto, C.

THE pre-operative, the operative and the postoperative treatment of goiter has undergone during the past 10 years changes which have been more or less revolutionary. The pre-operative changes in management have been directed toward placing the patient in a much more favorable position for operation. The operative improvements have been directed toward the avoidance of operative complications and postoperative recurrence. The postoperative regimen has been directed toward minimizing the postoperative reaction.

Enough time has elapsed so that our ideas have become crystallized as is evidenced by the fact that there has been very little added by way of improvement during the past 3 or 4 years. We may therefore with profit evolve the important points in goiter surgery which will at least remain important until further research discloses the etiology of goiter.

The important points in the technique of thyroidectomy have been impressed on surgeons by the operative and postoperative difficulties and it is by critical review of these difficulties that one arrives at a basis on which to judge the efficiency of any operative method. The important points in technique are the exposure of the gland, the ligation of the gland, which may be a little difficult depending on its degree of friability or its position, hemorrhage, recurrent nerve injury and parathyroid injury.

In order to judge the efficiency of the technique about to be presented a careful review as made of some 350 cases taken sequentially the idea being to learn if possible the complications directly attributable to operative technique.

No one can be completely regarded as recurrent laryngeal nerve injury, less the cases as followed by postoperative stridor, pneumonia, etc. However, from a practical standpoint I may state that if there has been no postoperative respiratory difficulty or alteration in phonation the surgeon must consider that he has completed

recurrent nerve injury until it can be proved otherwise.

The following technique has proved entirely satisfactory from every standpoint.

Step 1—Elevation of the skin flap. The incision must be placed so as to be symmetrical as to the patient on each side of the median line and as to level. It should not be too long and rarely should it be necessary to extend it beyond the middle of the sternomastoid on either side. It is not the length of the incision which determines the adequacy of the exposure. The incision must be placed neither too high nor too low. If placed too high the scar is noticeable and it is covered if too low. The time it stretches a delicate membrane slightly. With the head extended the midpoint of the incision should be about 1.5 inches above the episternal notch.

After the skin flap is elevated from the fascia all bleeding points should be secured and ligated with fine catgut. The field of operation should be made perfectly dry and skin to skin made preferably with gauze should be applied as necessary to permit operation.

Step 2—Exposure of the thyroid gland. To the occasional operator a lengthy exposure is of prime importance and this is secured in one way by making ample division vertically of the fascia between the strap muscles or later by crossing division of the strap muscles. The fascia on the surface of the gland is best divided by May's scissors. One must be careful that the last layer of fascia is separated from the gland so that the delirious of the lobe is visible. From the great secret of success in thyroid surgery is getting in all manipulation and it must be remembered that the incision tents particularly in the standing position.

Step 3—Separation of the thyroid gland from the fascia. This is done by careful dissection of the fascia in proper plane of dissection. Retracting the stage the operator must decide as to whether or not the exposure will be

FROM THE LAHEY CLINIC

A FURTHER SUGGESTION FOR THE OPERATIVE TREATMENT OF PILONIDAL SINUSES

FRANK H. LAHEY, M.D., F.A.C.S., BOSTON

A PILONIDAL sinus, a developmental lesion, is a skin lined cyst located between the buttocks over the sacrum, frequently contains hair, and frequently becomes infected.

In a study of a series of 59 patients with pilonidal sinuses, we have found that, to insure against recurrence, it is necessary to remove the entire sinus tract, which means that wide bloc dissection of the entire sinus tract together with much of the subcutaneous fat surrounding it must be done. All extensions of the sinus, laterally and subcutaneously down to the fibers of the gluteus maximus on either side of the sacrum, must be dissected. In the middle line, the dissection must likewise be carried down through all of the subcutaneous fat to the aponeurosis covering the sacrum.

The dissection of a bloc of skin and subcutaneous tissue extensive enough to remove the entire sinus together with its ramifications and an often associated abscess, leaves a large defect over the sacrum, as is shown diagrammatically in Figure 2, b. The large defect thus produced fills in slowly with granulation tissue and when the wound is completely healed, there results a dense, thick scar directly over the sacrum which must of necessity be subjected to a great deal of pressure

when the patient is sitting. This factor we have found to be the means of producing pressure necrosis of the scar. Therefore, healing can be accomplished only by relieving the area from pressure, but there is always the danger that the difficulty will return when the pressure is again applied.

To overcome this undesirable feature, we used a method which I described some time ago in this journal.¹ A pedunculated, fat lined skin flap was cut from one of the sides of the wound and was transferred to the midline, the free edge of the flap being sutured to the opposite edge of the wound (Fig. 3). In this way a fat lined skin pad was placed directly over the bony prominence of the sacrum. The lateral defect (Fig. 3), the result

¹Surg. Gynec. & Obst. 1929 XLVIII 109-111

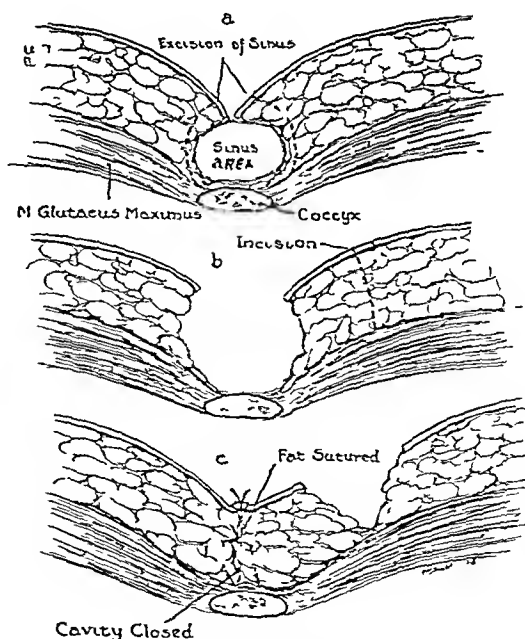
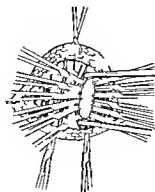


Fig. 1 Diagrammatic drawing showing the location of the opening of a pilonidal sinus. The shaded area indicates the extent of involvement by an abscess which may be associated with the sinus. The necessity for wide bloc dissection of these tracts to avoid leaving portions of the tract and to prevent recurrence is evident.

Fig. 2 This drawing is again published to emphasize a, the plan of bloc removal of the entire pilonidal tract, b, the large defect extending down to the sacrum, and c, how the complete separation of the flap (skin and subcutaneous fat) and its transference to the opposite side provides a fat lined flap directly over the bony sacrum.



F 4



Fg 5

drain. Never drain through the midline but always laterally through a stab wound through the outer edges of the strap muscles. By staying away from the midline the troublesome swelling is avoided which by the way is not always such a simple thing to fix. If the muscles have been divided they are sutured; if not the sternohyoid muscle is sutured approximating it by a continuous suture. The skin towels are

removed and the skin closed with clips, sutures being placed in the platysma. If drainage has been placed it remains 36 hours and if not the wound needs no dressing until the clips are removed on the third day. As a rule all dressings are off on the fourth or fifth day and at the end of 10 days some gentle massage is done by the patient to hasten the absorption of the operative exudate.

mation stitches, the fat lined bridge of skin thus resting directly over the sacrum and providing a soft, well nourished pad of tissue to withstand the pressure of sitting

As in the first procedure, the lateral defect left by moving this bridge of skin and fat to the midline may be closed by subcutaneous and skin approximation stitches, if it seems feasible, or the defect may be left open to granulate and fill in with scar tissue. When the scar filled defect is located laterally and over the large, soft gluteus maximus muscle, as it is in this plan, pain and pressure necrosis will not result.

The transference of a bridge of skin and subcutaneous fat nourished through attachment at both ends is superior to the pedunculated flap with a single area of attachment as used in the

older method, because the doubly attached flap is better nourished and therefore is better able to combat infection which so frequently complicates an operation on a pilonidal sinus, itself so often the site of infection. We have also found that necrosis of the flap does not occur when this method is used and that secondary sutures to hold the flap in the midline may be applied, if necessary, even in the presence of a granulating wound.

CONCLUSIONS

Wide dissections and complete removal of pilonidal tracts are necessary in order to prevent the recurrence of pilonidal sinuses.

The doubly attached flap here suggested has proved superior to the flap attached at only one end as previously suggested.



Fig. 3. The pedicled flap is prepared in the
right lateral incision. The flap is
raised by the pedicle.

of transferring the fat lined flap to the midline as thus located over the soft part of the buttocks with the base occupied by the gluteus maximus muscle. The defect was left to granulate and to fill in with scar tissue. The scar was thus transferred from over the long sacrum to lie over the soft gluteus maximus muscle.

While this procedure proved useful, a more modified operation so that the technique is simpler and the results are more satisfactory (Fig. 4).

Instead of producing a pedunculated flap to be transferred to the midline as shown in Figure 3, an incision is made lateral and parallel to one of the margins of the cavity after the sinus has been removed. This incision is carried down to the fibers of the gluteus maximus muscle. The incision is made far enough out from the wound edges so that a wide bridge of skin and fat is freed (Fig. 4a). The lateral incision is made long enough so that the bridge of skin and fat can be readily approximated to the opposite edge of the wound. The fat underneath and lining the bridge of skin is completely detached from the underlying gluteus maximus (Fig. 4c) so that the entire fat lined bridge of skin can be shifted to the midline and held there by lateral approx-



Fig. 4. The lateral incision is made parallel to one of the margins of the cavity after the sinus has been removed. This incision is carried down to the fibers of the gluteus maximus muscle. The incision is made far enough out from the wound edges so that a wide bridge of skin and fat is freed. The lateral incision is made long enough so that the bridge of skin and fat can be readily approximated to the opposite edge of the wound. The fat underneath and lining the bridge of skin is completely detached from the underlying gluteus maximus so that the entire fat lined bridge of skin can be shifted to the midline and held there by lateral approximation.

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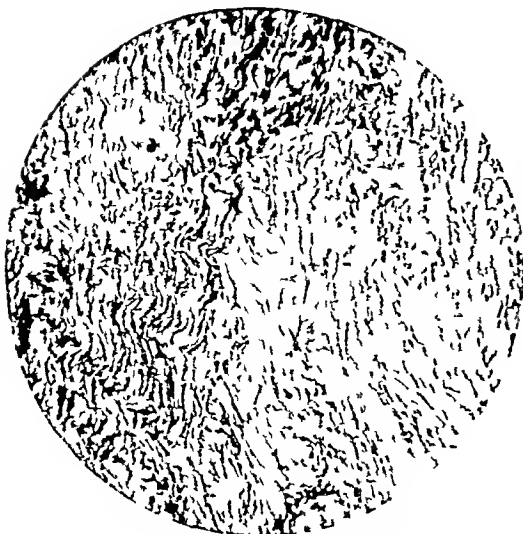


Fig 3 In the paler regions the fibroblasts and cells are spread apart by oedema. The darker half is mainly collagen fibers stained with phosphotungstic acid hæmatoxylin.

tain other elements than fibrous connective tissue (chondro-fibromata, osteofibromata, fibrolipomata, fibro-adenomata, etc.) Nor was it possible to include those fibromata which are merely mentioned in the classification of types in series of renal neoplasms, to the effect that in a given series a fibroma was found but the clinical data were lacking.

PATHOLOGY

Renal fibromata may take their origin in any part of the kidney. In 3 cases the tumor had its origin in the kidney capsule, in 1 case in the upper pole, in 1 case the growth gradually distended the kidney capsule, destroying by pressure the kidney substance but preserving in general the normal kidney contour, in 1 case the tumor developed between the cortical and medullary portions, in 1 case the tumor, which was pediculated, hung into the renal pelvis, in 1 case the tumor was "embedded" in the kidney, in my case the tumor occupied the middle third of the kidney, in the ventral half, in 2 cases, the origin was not given.

These fibromata have been described as having the same firm consistency and homogeneous, grayish-white appearance typical of this type of tumor. They are frequently mentioned as having undergone mucoid and pseudocystic degeneration in portions. Microscopically, they are found to consist of fibrous connective tissue but they show no special characteristics.



Fig 4 A collapsed empty blood vessel is in the center of the top. On the left side of this are many fibroblasts with the nuclei flat, seen from the sides, so they appear oval and faintly stained. On the right of the vessel the nuclei of many fibroblasts lie edgewise, are darker, slightly wavy, and in places parallel.

The right kidney was the site of the growth in 5 cases and the left in 3 cases, in the case herein reported the tumor was located in the right kidney and this information was not given in the other reports.

ETIOLOGY

With regard to fibromata of the kidney, Ewing states that "these growths must owe their origin to some developmental disturbances of the kidney." In this regard we may mention that in the cases reported by Park and Wahl, the tumors occurred in children of 2 and 11 years respectively.

Garceau is of the opinion that the fibromata which become important clinically have their origin in the small fibrous nodules which have previously been mentioned and are not infrequently found at autopsy. These nodules "may become active and attain a large size."

AGE

The youngest age of occurrence in this series was 2 years (Park) and the oldest 53 years (Wilks). In 2 cases the growth occurred before the age of 20 years, 4 between 20 and 30, 2 between 30 and 40, 1 between 40 and 50, and 1 after 50 years. The patient here reported was 38 years of age.

SEX

The case reports did not always mention the sex. In the series there were noted 5 females and 4 males, including my case.

SYMPTOMS

As observed by Stillman, Morris, Clark, and others, renal fibromata, until they have attained

FIBROMA OF THE KIDNEY

N	A b	A	Se	Ch f ym ma	D	C _d l	T	Loc so	Ou	Comm
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	Bru zel		F	L b f m f mo			N h my	L f k d	R y	T h d on f m k d y h d po da
	Th mas		F	Abd mu l m	ze gm	On	N h my	Lo pol f f k d	R ry	T m d m h m k d y p l i f m k d d
	Cl us Sa	6	F	Abd m l m		On	N h	R h k t	R	T m d l d b m d l ry
	W bl Boj			Abd mu l mo	ra	B gm l	N phr	L h k d f	R ry	T m Sh i b f f m k d d m d m (i)
	P k			Esilar m bd m l bl m b h	S f m b h	T m f h k d y	N hr	R h k d ey	Good m l d	W h d po d Sh i ey h
	Clark	8	F	F (h d) M as k d (b u f)	y	N w h d som k d	N hr my	R h k d ey	C d l l m l	d N ry d b es h
	K h d h d	6	F	An m d) pad bl l f la y	ym	hemp m f l f y	N h ec m	Lef k d	R ry	T m d mb l l d k d b b ec f m
	Boross		M	Herna us			Nephrectomy		Rec ry	P d l d k pad
	S tale		A	Le f las paan m m l u er	k be ope	R rad on laum	N h ec m	Lef k pe po	ecov	
	Kretsc mer			m m la hr	das	T m er ad ey	epidasc	ec er	ecov	ve Gory ka ad po wa lase am

THE DEVELOPMENT OF THE MERCUROCHROME TECHNIQUE IN OBSTETRICS

A REPORT OF TEN THOUSAND CASES, FIVE THOUSAND OF WHICH WERE STUDIED DURING
THE EXPERIMENTAL STAGE

H W MAYES, A M, M D, F A C S, BROOKLYN

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ONE of the greatest problems that confronts the medical profession of this country today is to find means to reduce maternal morbidity and mortality. A large sum of money has been given in order that a study may be made of puerperal deaths in New York City and with the hope that the reason for the mortality rate may be determined. The medical as well as the lay press publish hundreds of articles deploring the present situation, physicians are criticized and statements have been made that the expectant mother is safer in the hands of a midwife than surrounded by the latest hospital methods of combating shock, hæmorrhage, and the accidents incident to childbirth.

I believe that it is generally admitted that we have made progress in the treatment of toxæmia, contracted pelvis, and postpartum hæmorrhage and that therefore a patient with any of these complications is far safer in the hands of a physician. It is also true, however, that when it comes to the prevention of deaths from puerperal septicæmia, year after year brings the same grand total. Would it not be well for us to stop to consider what we are doing to combat this ever present condition? A brief survey of the routine perineal and vaginal preparations as practiced in the majority of hospitals will soon convince us that the methods used to prevent "child-bed fever" are little better than they were 25 or even 50 years ago. To my mind, there is little use in being careful to sterilize drapes, instruments, gloves, etc., only to leave undisturbed the vagina with its sacred pathogenic organisms.

The medical profession as a body is hard to convince. What they were taught and what was good enough for them during the last 25 or 50 years is still good enough. One doctor will say that he has been doing obstetrics for 10, another for 15, and still another for even 25 years, and that he has never lost a case from puerperal sepsis. This may be true, but it is no reason why he should not advocate or teach the sterilization of the vagina especially when apparently all other methods and teachings have failed to reduce the death rate from puerperal sepsis.

Some claim that the great drawback to vaginal antiseptics is that it may lead to more meddlesome midwifery than at present. We have about reached the highest pinnacle in meddlesome midwifery. If the doctor would examine his patient more carefully and not rely on rectal and abdominal examinations, he would be not only a better judge as to whether a patient is abnormal, but undoubtedly he would be a better obstetrician. Unquestionably cesarean sections would be less frequently done if patients were more carefully examined, if doctors were not so fearful lest their patients become potentially infected, and if the patient were given a test of labor before being subjected to the ordeal of cesarean section.

In an article entitled "Mercurochrome as an Antiseptic in Obstetrics," Baldwin reports a series of 61 cases in which he used 1 ounce of a 2 per cent solution of mercurochrome in the vagina every 6 hours during labor, with a morbidity of 13.4 per cent, as compared with 80 cases in which no mercurochrome was used, with a morbidity of 22.5 per cent. He states that "mercurochrome has not reduced maternal morbidity to any marked degree." I am convinced, however, that if his series were larger and the technique properly carried out, his results would be more strikingly favorable.

Henderson showed a reduction of 42 per cent in the maternal morbidity of 100 consecutive cases in which mercurochrome was used, when compared with 100 cases without mercurochrome. He states "There is a certain added sense of security which this procedure gives to the mind of the obstetrician, especially in those more critical and difficult situations."

Brown reports a series of 5,385 deliveries in which he used a solution containing 15 grams of mercurochrome crystals, 5 cubic centimeters of one-half strength iodine, and 500 cubic centimeters of glycerine, with 11 deaths from puerperal infection, 7 of which were infected before admission to the hospital. He compares this with 2,194 cases with 10 deaths, 5 of which were infected before admission to the hospital, the percentage being 0.45 without sterilization of the



Fig 1



Fig 2



Fig 3

Fig 1 Syringe which we have used for the vaginal instillation of mercurochrome for the last 5,000 cases. We attribute our success with the mercurochrome technique to the use of this syringe.

Fig 2 Roentgenogram taken following instillation of the vagina with a catheter and small syringe. An opaque solution was used instead of the mercurochrome. The vagina

is not distended and the instillation by this method is unsatisfactory.

Fig 3 The result when the proper instillation of the vagina is done by means of the aseptic vaginal syringe. The vagina is ballooned so that the rugæ are visible and the mercurochrome is forced into the cervix and folds of the vagina.

part. The instillations were done at least every 8 hours but frequently, in order to follow the course of labor, they were repeated oftener.

Examinations. From 1923 to 1926 the progress of labor was followed by the use of rectal examinations, and vaginal examinations were done only when indicated. Beginning January 1, 1926, all cases were followed during this year by the use of vaginal examinations alone.

Morbidity. During this year there were 1,740 deliveries with a morbidity of 9.2 per cent.

Publication. An article entitled "Morbidity in Obstetrics—Its Reduction by the Use of Mercurochrome as a Vaginal Antiseptic" was published during this year and reported 1,118 cases following the mercurochrome technique, with a morbidity of 6.8 per cent, as compared with 2,072 cases without mercurochrome, with a morbidity of 12.4 per cent.

1927

The very apparent increase in morbidity during 1926 over the previous year was possibly explained by the fact that although it is possible to do the instillation properly at the time of vaginal examinations, this method as a routine is not entirely satisfactory because the examining fingers of one doctor may be properly adapted for doing pelvic examinations while others, because of their size or shape, may be improperly suited.

Technique. We were convinced that this fact increased our morbidity during 1926 and at the beginning of 1927 we went back to the catheter and small syringe method of instillation as carried out during 1925.

Examinations. Rectal examinations were routine and vaginal examinations done only when indicated.

Morbidity. In 1,853 deliveries in 1927, there was a morbidity of 9.6 per cent.

During the spring of 1927 there were so many deaths from puerperal sepsis in New York City that we became rather discouraged because of our high morbidity and increased mortality from sepsis. However, other hospitals were reporting similar epidemics and some even being obliged to close their doors to new admissions.

Publications. An article was published during 1927 entitled "The Use of Mercurochrome in the Preparation for Delivery." This paper described a study of the different methods of preparing the external genitalia before the application of mercurochrome, with the following results: In 74 cases in which the perineum was clipped without cleansing and mercurochrome was applied, the morbidity was 6.7 per cent. In 50 cases in which the clipping was followed by cleansing with soap and water before the application of mercurochrome, the morbidity was 4 per cent. While in 262 cases in which the perineum was thoroughly prepared by shaving and cleansing, the morbidity was 9.2 per cent.

Also during this year an article entitled "The Use of Mercurochrome as a Vaginal Antiseptic in the Induction of Labor" was published, which detailed 93 cases in which

vagina and 6 to 20 with sterilization. He states that anaerobic streptococcal puerperal infections will perhaps be best reduced by using some antiseptic preparation in the vagina at the beginning of and during labor. At the present time we recommend no particular preparation but hope to determine by experience and experimental work what solution will prove most efficacious. We predict that this subject will be one that will command one of the most important investigations of the coming problems of modern obstetrics.

In an article entitled "Puerperal Morbidity without Disinfection of the Vagina" Gordon reports 2016 cases with a gross morbidity of 3.6 per cent. This is certainly an enviable record especially when we consider the fact that the majority of the patients were delivered by the interne staff. He recommends the application of a 3.5 per cent tincture of iodine solution in the preparation of the perineum. According to the work of Rains and his collaborators a 2 per cent aqueous solution of mercurochrome is preferable to a 5 per cent tincture of iodine as post-operative growths were obtained in all tests when the iodine was allowed to come in contact with the skin for 15 minutes. While he reports 33 per cent negative cultures with mercurochrome and with the acetone mercurochrome only a 1 per cent solution being used 87 per cent negative. Also if the 2 per cent solution of mercurochrome was allowed to come in contact with the skin for an hour all the tests were negative. While with the iodine no negative tests were obtained. Patients object strenuously to the irritation and burning from the iodine itself as irritant to the skin of the perineum and the sensitive mucous membrane of the vagina. Gordon admits that infection may occur from within or without but doubts that the reduction of the number of bacteria in the vagina could minimize the risk.

The possible value of vaginal ant sepsis was first brought to my attention during the month of February 1944. Mrs M had had a normal delivery and was returned to her bed following the delivery of her first child 2 years previously. She had had a postpartum haemorrhage which was checked with difficulty. Realizing this and in view of the fact that she continued to bleed, we deemed it necessary to pack the vagina. I decided to use a 2 per cent aqueous solution of mercurchrome for the perineal preparation. This was applied only to the perineum and the vagina was packed with plain gauze. This patient would have had a normal convalescence but she developed a postpartum infection, was in the hospital for 75 days and after returning home she was

an invalid for months. The question arose as to why this patient developed a postpartum sepsis. Sterile gloves, drapes, instruments etc. had been used and the perineum had been carefully disinfected but we had left the vagina absolutely alone. This omission undoubtedly was the cause of her postpartum illness. The outcome in this case was the incentive for beginning the use of mercurochrome as a vaginal antiseptic in the Methodist Episcopal Hospital.

DEVELOPMENT OF THE MERCUROCHROME TECHNIQUE YEAR BY YEAR

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During 1924 the outcome of the mercurochrome technique did not seem so brilliant and it was thought that our results might be better if we instilled the vagina at the beginning of labor.

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19 6

We were not satisfied with our results during 1955 and thought perhaps it might be better to install all of the patients at the time of vaginal hysterectomy. This would do away with the extra incisions during labor and was an experiment on our part to test out this method of installation.

Technique Two figures inserted into the
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With our present technique, which has been used almost 3 years, we trust that our low morbidity will continue.

The question has been raised repeatedly as to whether the instillation should be repeated every 6, 8, or 12 hours. A study of Table II will show that in 30 cases either no mercurochrome was used or instillations were made at the time of delivery. In 46 cases the mercurochrome did not remain in the vagina over an hour before delivery. In 68 patients instillations were made from 3 to 6 hours before delivery, in 33, from 6 to 9 hours, and in 17, from 9 to 12 hours. In 89 cases mercurochrome was instilled over 12 hours before delivery, and of these in 68 more than one instillation was made.

If we omit the 30 cases with a morbidity in which the mercurochrome was either not used at all before delivery or used only at the time of delivery, we would have a morbidity of 5 per cent.

The morbidity percentage does not tell the whole story. In fact, I feel that a better representation of the morbidity is conveyed when the total number of days' morbidity is enumerated, and then the average number of days' morbidity per patient, as is shown in Table III. When we first began the use of mercurochrome, it was the decrease in the days' morbidity in the mercurochrome group that was encouraging in spite of the fact that the morbidity percentage was higher with mercurochrome. If our only aim had been to send our patients home from the hospital alive, then we might say that the only morbidity worth considering was the morbidity that was severe enough to cause maternal deaths. This could very easily be corrected to the deaths from sepsis.

A study of Tables III, IV, and V is very instructive. The average days' morbidity per patient before the use of mercurochrome was 0.40, 0.46 during the experimental stage, and with the present directions carefully followed, the average days' morbidity for 5,102 cases is 0.26 days per patient. Table V shows that during 1923 and 1924, 78 patients had a morbidity of 2 days each, while in the experimental mercurochrome group, 140 patients had a morbidity of 2 days, and in the latest mercurochrome group there were 100 patients with 2 days' morbidity. In other words, if we were to omit the patients with 2 days' morbidity in the last 5,102 cases, we would have a 33 per cent reduction in the morbidity. Another very striking comparison is in the number of patients who had a morbidity of over 20 days. Without mercurochrome the ratio was 1 in 345, in the experimental mercurochrome series it was 1 in 390, while in the last mercurochrome group

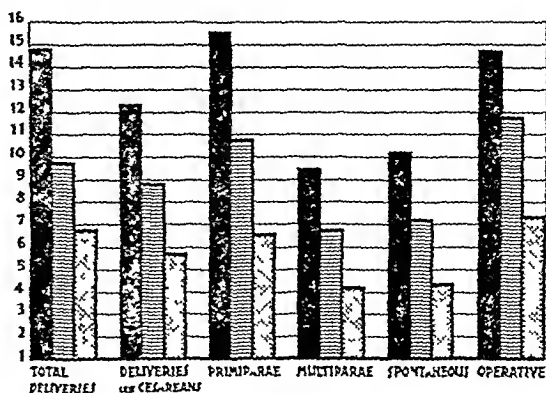


Chart 2 Comparative study of the percentage morbidity for the three groups of cases. The first bar represents the years from 1923 through 1924, the second bar, 1925 through 1927, the third bar, 1928 through July, 1930.

there were only 7 cases in 5,102 deliveries, or 1 in 728. An analysis of these is shown in Table VI.

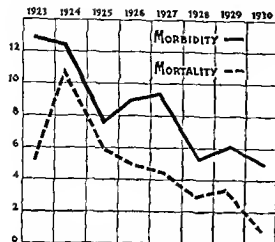
In 3 cases in Table VI deliveries were spontaneous. In 1 case instillation was done at the time of delivery and in another at the time of induction. Labor was short in all but 1, who developed a bilateral phlebitis. The 2 patients who developed pelvic abscesses had no vaginal examinations, very short labors, membranes intact until a short time before delivery, and both were multiparæ.

Table VII shows the total number of deliveries for each month and the percentage of morbidity. March, as would be expected, has the highest morbidity rate, but this is accounted for to a great extent by the fact that during the year 1927 we had a severe influenza epidemic with a morbidity in 28 cases. If we omit the cases delivered and the morbidity for March, 1927, it gives us a morbidity for that month, for the 4 years, of 8.1 per cent.

In the months of September and November the morbidity was comparable with that of January and February. The lowest rate was for December, a winter month, when a higher morbidity would be expected. July and August, the summer months, carried the largest number of deliveries.

A careful scrutiny of this table would lead one to believe that the season of the year has very little to do with the percentage of morbidity when thorough vaginal antiseptics is carried out.

Table VIII shows the corrected and uncorrected morbidity for the years 1928 to 1930, in which a large percentage of the morbidity is classified as being due to lochiometra and sapræmia. In these patients the morbidity was of very short duration, 2 or 3 days. The findings were generally represented by a moderate degree of subinvolution of the



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m c ch m w t d d th m b d t y 9
p t m p e d th m b d t y f 5 p t
7 8 a s t t e f l y th m h m t h q

928

It was during 1927 that we discovered that the mercur chrome did not always reach the vaginal vault when the catheter and syringe method as used. While taking a cervical culture following the routine instillation I found that on introducing the speculum the upper third of the vagina was entirely free from mercurochrome.

T h a q O t b y w h g d m t h o d f
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q l h l t s o l t m r c o c h r m
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w d t t h m t h g h n t l t b y m n s f t h
y r i n g d t h f t t t h q u s l l l t
l i t w d t h p m

A l g m b f t h p t d n g 9 8 w e m
m e d f e q t l y i n d t e c u l t e s f t d y f
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t e s i f t h m c u o c h r m t e c h q h a d t b
u e d t h l d i c r t h m b d t y

P b l t A t d y f t h m b d t y f l l w a g c a s e a n
e a n a c t i o n w a s i m p e d d n g t h y e a 8 a s e a n
s e c t o n a b e g p o r t e d i n w h h t h m r c o c h m t h

m q w a u e d t h m b d t y f 4 p t a s
p e d t h w h h t h m r c r u h m t
d w i t h m b d t y f 5 7 5 p e t

1929

T h a q S m t h t u s e d 9 8
E m n a t O n t h r e c o d b t l s e r v l a r e
m b f t h p t s w e s t t d t g a l r a m t
n a t w h l t h f i t b i t a c l
m a t w t
M b d t y Th 9 7 d l e s t h m b d t y
f 6 p t

1930 (7 months)

T h a q S m i n 9 8 d o g
F m n a t S m 9 9
M b d t y Th w 5 5 d h e s d t h f i r s t
7 m t h f 9 3 w i t h m b d t y f 5 5 p e t
T h w n l y m t n a l d t h w h b l d b i d t
p d d t h p a t t w l y 5 m t h p r e g n t
d h d h a d c h i l l s d i f b e f d m t t h h o s p i t
t a l M r c u o c h m w d l y t t h t i m f d l r y
P b l t A t l t l d A B t l g e a l
S t d y f t h V l e f m r o c h r m V m l a n t
p t s w i t h P t l a R f t t U n O b t r a l
C s h w l t h a t t h m b f p o t u l t f r o m
t h g i w e d d f m 4 4 p e n t t 6 p e
f m t h 6 p e t t 4 p t f m t h m
b e 3 p e t t 6 4 p t

Table I shows a detailed analysis of the deliveries with the result given morbidity for the three periods (Chart 2). During the first 923 through 94 before the use of mercur chrome the 0.072 deliveries exclusive of caesarean section with a morbidity of 1.4 per cent. The years 93 through 1927 covered the experimental period during which the best technique for vaginal instillations was being established. During this period there were 5076 deliveries with a morbidity of 8.9 per cent. One variation in technique was made in that on the second obstetrical review a large number of the patients were subjected to vaginal examination to determine whether or not this would influence morbidity.

It is evident from a study of the comparative percentages for the different periods that there has been a steady decline in morbidity in practically all conditions represented in the table. Primiparae show a higher morbidity than multiparae operative deliveries a higher morbidity than spontaneous deliveries. Each delivery in past 3 years showed 5.9 per cent morbidity as to term 44 caesarean section all degrees of term a morbidity as 4.09 per cent.

Previous reports and publications have included all the mercur chrome deliveries with the percentage of morbidity. This is similar to the technique which has been established at the present time. Many of these have used mercur chrome in obstetrics have obtained poor results because they still follow the original technique.

TABLE II—HOUR OF INSTILLATION

	Morbidity Cases 19 8-30
At delivery	15
No mercurochrome	15
Mercurochrome given less than 1 hr before delivery	16
Mercurochrome given 1 to 2 hrs before delivery	15
Mercurochrome given 2 to 3 hrs before delivery	28
Mercurochrome given 3 to 4 hrs before delivery	30
Mercurochrome given 4 to 5 hrs before delivery	17
Mercurochrome given 5 to 6 hrs before delivery	21
Mercurochrome given 6 to 9 hrs before delivery	33
Mercurochrome given 9 to 12 hrs before delivery	17
Mercurochrome given 12 hrs or over before delivery	21
Mercurochrome given 2 times	50
Mercurochrome given 3 times	18

TABLE III—A STUDY OF THE DAYS' MORBIDITY

	19 5-24	19 5-27	19 28-30
Total days' morbidity	2072	2352	1355
Average days' morbidity per patient	0 40	0 46	0 26

100 degrees for a single day during the puerperium. What is the use of reporting the morbidity in a group of 100 cesarean sections and saying that all but 10 or perhaps 15 had a morbidity? I am of the opinion that the standard which we have adopted at the Methodist Episcopal Hospital is too stringent in such cases and hence they are given separate from vaginal deliveries. In a large number, this rise in temperature is a reaction which should not be considered a morbidity.

We have accepted the standard of the American College of Surgeons and also the Congress of Vienna, namely, a rise in temperature to 100 4 degrees on 2 consecutive days, not including the first 24 hours and occurring on or before the tenth day. If the patient has a rise to 100 4 degrees on the tenth and eleventh days postpartum, we consider it a morbidity. I understand that in some clinics if the temperature does not rise to 100 4 degrees until the tenth day, it is not included.

The interpretation which we put on this definition may change the percentage of morbidity. If we would say, for instance, that the temperature had to stay above 100 4 degrees for 24 hours, then the morbidity which I have given would be reduced over 50 per cent, because nearly all patients, even with a temperature of 103 degrees on 2 consecutive days, will invariably drop below 100 4 at some time during the 24 hours. As I understand the exact reading of the report from Vienna this is the interpretation we should put upon it. Then again, can you imagine what effect it would have on the morbidity if the temperatures were taken carelessly, if the temperature were charted without being taken or perhaps the temperature taken only in the morning and not in the afternoon, when it is likely to be the highest? I do not believe

TABLE IV—A STUDY OF THE DAYS' MORBIDITY

	19 5	19 6	19 7	19 8	19 9	19 10	19 11	19 12
Total deliveries less cesarean sections	877	1195	1,833	1,833	1,878	1,975	1,157	1,157
Total days morbidity	335	499	433	811	1,165	772	537	351
Average days morbidity per patient	38	41	23	46	54	23	27	30

TABLE V—DAYS OF MORBIDITY

Days	19 5-7	19 8-10	19 11-12
2	78	140	100
3	51	92	67
4	36	64	36
5	20	36	33
6	7	26	12
7	12	20	10
8	7	14	6
9	3	13	5
10	2	3	6
11	4	5	2
12	2	3	2
13	4	2	1
14	0	2	0
15	3	4	0
16	1	0	1
17	0	2	0
18	0	0	1
19	0	1	1
20	6	13	7

that it is necessary to take the temperature every 4 hours during the entire stay of the patient in the hospital, but we believe that it is essential the first 8 or 9 days, and thereafter it should be taken at least twice a day, one of the temperatures being recorded at 4 p m, and if at any time the temperature reaches 100 degrees, it should be taken every 4 hours.

Mouth temperatures have been the routine at the hospital, except in operative cases. When the temperatures are taken by rectum, they are, of course, higher than when taken by mouth. We have frequently checked the mouth and rectal temperatures in the presence of a morbidity and found a distinct variation, but it was seldom as much as one-half of a degree and at times they were identical. The question arises whether or not we should consider such temperatures a morbidity. We have determined our morbidity by the record as charted on the temperature sheet.

I made a study of 100 consecutive charts and found that 46 had at least one rise of temperature to 99 degrees, 16, to 100 degrees, 10, to 100 4 degrees, while if we use the standard of the American College of Surgeons, we have a morbidity of 2 per cent. If a temperature of 100 6 degrees was used instead of 100 4 degrees, the morbidity was the same, but if we required the temperature to stay over 100 4 degrees for 48 hours, the morbidity was zero in each case.

SURGERY GYNECOLOGY AND OBSTETRICS

TABLE I—MORBIDITY REPORT FOR THE YEARS 1933

	W h m cu och me 3 4			E perim tal 5			P tech qu 8-30		
	C s	M b d	P morbidity	C s	M b d	P morbidity	Cases		
D l es	96								
Cesa se		6	5 6	5 5	5	9 9		6	8
D l less resa se	7	3		7				7	
Ward	8					8		3	
P		5		080			8		6
I m ar		6	5	906		8	5	48	
M l ar			0	58	78			38	6 3
Sp ta	5			80		6	53	00	
Op	90		8	844			3	6	
Lo d pr h lac f ep	6 5	80			6	6	66		01
M d m f			08						6
H b f		3					5	3	09
Ax tr				7					
Bar									
P									
V							6		
I l	3								3
B h	06			7		8	60		
S						7			
L f io	009		5			8	06		8
R h			8			5			
Lef oc te			8						
R h oc pos	5	8							
Pl ta p vi						6			6
E lam sia								7	
T mia									5
L l lo			6	8	6				09
M d m			3		6				
				8	6	8			

uterus and at times the presence of foul lochia

It will be noted that during this period there was no note on the chart of 39 of the patients as to the cause of the morbidity or the examination was negative. In many of these patients the temperature would reach 100.4 degrees on days only and was overlooked by the man signing the chart.

In those cases in which morbidity was noted due to delivery respiratory conditions we are opposed to account for the condition in 4 cases while the breasts are blamed in 4 pyelitis accounted for 35. Twenty occurred during 99 and only 5 during the year 1938.

THE STANDARD OF MORBIDITY

When we consider the different standards of morbidity it is very hard to say which one is right. It would seem better to accept the one which is most universally adopted. There are undoubtedly a great many maternity patients who have some rise in temperature during the puerperium which means little or nothing as far as the well-being is concerned. There are others who have a prolonged morbidity and they may not die but are left invalids for months or perhaps for life and still they are classified with the other patients who have a rise in temperature. I save

TABLE VII—MORBIDITY BY MONTHS
1925 THROUGH 1929

	Deliveries	Morbidity	Per cent
January	707	58	8.2
February	659	63	9.5
March	737	74	10.04
April	737	57	7.7
May	790	49	6.2
June	728	54	7.4
July	822	64	7.7
August	813	47	5.7
September	778	65	8.3
October	782	53	6.7
November	773	63	8.02
December	703	38	5.4

syringe, the barrel of the syringe tends to keep the mercurochrome in the vagina, but even in spite of this, a large part of the fluid will escape without ballooning the vaginal vault. We have had considerable difficulty in getting our internes to carry out this part of the technique.

A thick pad under the patient will absorb the spill from vagina and saves staining the bed linen.

Care of the perineum during labor. The perineum should be thoroughly cleansed, three moist sterile sponges being used, and the spraying and instillation should be repeated every 12 hours. It is very important to keep all the dried blood and mucus from collecting on the perineum. This should be removed every 2 or 3 hours during active labor.

Vaginal examination. The perineum is thoroughly cleansed with three or more moist sponges, the sponge being discarded as soon as it comes in contact with the anal region. The perineum should be sprayed. The labia are separated with the gloved hand, and the introitus is sprayed. The first two fingers are inserted into the vagina, the pelvic floor is depressed, and 2 drams of mercurochrome is put into the vagina from a small aseptic syringe. (If the mercurochrome solution is used carelessly a large amount may be wasted. The cost of the mercurochrome should not be more than 10 or 20 cents per patient.) The separating and withdrawing of the fingers will allow the mercurochrome to reach the upper part of the vagina. When a vaginal examination is made at the time of admission, the mercurochrome need not be used in the vagina but immediately following the vaginal examination, the vagina should be instilled as described above.

Preparation for delivery. The perineum and surrounding area should be cleansed with three or more moist, sterile sponges, all dried blood and mucus being removed, then dried with a sterile towel, and sprayed with a solution of 4 per cent aqueous, alcohol, acetone mercurochrome. The spraying should be done systematically, beginning

TABLE VIII—ETIOLOGY OF MORBIDITY FOR THE
YEARS 1928-1930

Total deliveries	5102
Uncorrected morbidity	56
Corrected morbidity	301
<i>Due to delivery</i>	
Lochometra	50
Endometritis	2
Parametritis	3
Sapraemia	17
Retained membranes	2
Retained placenta	2
Subinvolution	2
Infected perineum	9
Phlebitis	1
Bacteraemia	1
Pelvic abscess	2
Salpingitis	1
Thrombophlebitis	1
Unclassified	22
No note	27
Examination negative	12
<i>Not due to delivery</i>	
Respiratory	42
Breast	40
Intestinal	5
Cholecystitis	2
Pylitis	35
Otitis	1
Rheumatism	2
Genito urinary	2
Pyonephrosis	2
Encephalitis	1
Parotitis	1

over the pubes and moving the atomizer back and forth across the field as the bulb is pressed, until the whole area is covered. *Never use the acetone solution for the instillations.* After the pelvic floor is depressed, 2 drams of the aqueous solution are put into the vagina. If a forceps is to be applied, an induction to be done, or if considerable time is consumed in the delivery, more mercurochrome should be used in the vagina. If the perineum becomes soiled with feces, it should be cleansed with a moist sponge, more mercurochrome instilled, or the perineum sprayed with mercurochrome. After delivery, if there is any laceration of the pelvic floor, or if an episiotomy wound is to be sutured, the blood should be cleared away and mercurochrome should be put into the wound before it is sutured.

Induction of labor. At the time of the induction, which should not be less than 1 hour after the original instillation, the patient is prepared as for delivery. The vagina is filled with a 4 per cent solution of mercurochrome. The cervix is located and the bag is passed through the cervix and filled with a weak solution of mercurochrome. After the stem has been tied, a hand sponge saturated with mercurochrome is inserted into the vagina. If the membranes have been ruptured for any considerable time or if the uterine cavity is considered potentially infected, a small catheter should be inserted into the uterus when the bag is introduced. After the bag is filled, 3 ounces of a 1 per cent solution of mercurochrome may be injected into the uterus through the catheter. The bag may remain in the uterus for 24 hours without danger of infection.

Cæsarean section. On admission to the hospital the patient should be prepared and instilled as in

TABLE VI—PROLONGED MORBIDITY

Case	Par	Days morbid	Examina- tion	Morbid nature	Morbidity	Duration	Delivery	Cause of morbidity
600	V	6	0-0	h	m. bel l. ry	7 h 6 min	Spontaneous left oblique N. l. tion	P. l. lacer.
	I		6-	Tim	35 h	hrs	Med. m. f. l. p.	Bleed. at h. lacer.
6	A	11	0-	hrs		hrs	Spontaneous left oblique N. l. tion	T. laceration of lip.
98	I		2-8	T. lacer.	5 min	3 hrs	P. l. lacer. forceps, right oblique N. l. tion	Bleed. at h. lacer.
	II	3	0-	A. and c.		hr min	Prop. l. lacer. forceps N. l. tion	Encephalitis Chorea
61	VIII	6	0-0	A. d. l. ry	unl	5 min	B. lacer. N. l. tion N. l. tion	Perineal lacer.
	I		2-0	h	hrs	hrs	Spontaneous right oblique N. l. tion	Abscess of leg N. l. tion

At the beginning of this work at the Methodist Episcopal Hospital I made very little effort to correct the morbidity because many of these cases were not recognized as morbidities by the attending physicians and so they made no note on chart. Thus it was impossible to correct the morbidity.

TECHNIQUE

Preparation on admission. The pubic hair is shaved off and the perineum and surrounding field are cleansed with green soap and water making sure that all sebaceous material is removed from the labial folds.

The external genitalia and surrounding area are sprayed with a 4 per cent aqueous solution of mercurochrome. We have been using a De Vibiss atomizer for the spraying of the mercurochrome solution but we find considerable difficulty in keeping the atomizer working properly. The spray is too fine and unless considerable care is taken the area is not properly covered. I have been endeavoring to get a better suited atomizer for this purpose. At all events the atomizer should be cleaned daily and if a stilette is kept in it when not in use it will add considerably. If the atomizer does not work properly a stick sponge saturated with mercurochrome can be used to paint the perineum.

The aseptic vaginal syringe (Fig. 1) that we are now using should have an outside diameter of $\frac{3}{8}$ inch and a barrel 7 inches long with a circular mark to indicate a capacity of 3 drams. The syringe should be filled with mercurochrome to this point. Then the labia are separated and the point of the syringe is passed along the vaginal

floor until it reaches the vault of the vagina. After the syringe is inserted properly the labia should be held close together around the syringe with the thumb and finger of a gloved hand. This keeps the fluid from leaking when the bulb is pressed causes the fluid to enter the vagina under slight pressure and insures its coming in contact with the entire vaginal mucosa. Figure 2 represents the amount that would come in contact with the vaginal mucosa when the instillation is done by means of a catheter and small syringe. This method was used for 2 years during the experimental work with mercurochrome in obstetrics. It is evident that a very small amount of the mercurochrome remains in the vagina and the are parts of the birth canal which remain free from the drug. In Figure 3 when the syringe is used properly it will be noted that the solution extends the vault of the vagina is undoubtedly forced into the cervix if pen and the entire vaginal mucosa comes in contact with the drug. If the labia are not held closely together or if the instillation is done when the cervix is fully dilated and retracted past the presenting part it is evident that it is impossible to instill the vagina properly. This is the reason why we insist that the instillation be started as near the beginning of labor as possible. Two small sponges held on either labium will keep the gloved hand from slipping and as the syringe is withdrawn and the excess fluid starts to escape it may be collected in the syringe by releasing the bulb a distance of 1 inch from the side of the syringe. A fluid not taken up by the syringe is absorbed by the sponges. If the labia are not held closely together around the

NOTE—Up to the present there have been 8,077 deliveries with the present mercurochrome technique, with but a single death from puerperal sepsis following the vaginal delivery of a viable child. The following is an analysis since August 1, 1930

	Cases	Morbidity per cent
Total deliveries	2798	6.8
Cesarean sections	103	47.5
Deliveries less cesareans	695	5.2
Corrected morbidity		2.5
Average days' morbidity per patient		0.70
Longest period of morbidity		15 days
Number of maternal deaths		4
Deaths from sepsis		0

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CARCINOMA OF THE TONSIL

A REVIEW OF ONE HUNDRED TWENTY-TWO HISTOLOGICALLY PROVED CASES TREATED
1921 TO 1928, INCLUSIVE

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CARCINOMA of the tonsil is not as infrequent as is generally believed. By the term tonsil is meant both the tonsil and tonsillar pillar, because the disease has usually so far progressed when first seen that the site of origin is not certain.

Pack and Le Fevre in their survey of 19,129 admissions to the Memorial Hospital between January, 1917, and January, 1929, found that 1.93 per cent were suffering from carcinoma of the tonsil. These lesions constituted 2.23 per cent of the malignant tumors included in the survey. Of the intra-oral group of tumors, carcinoma of the tonsil accounted for 9.64 per cent, more than ten times the incidence of lymphosarcoma, which was 0.83 per cent of the intra-oral tumors. In the oral group of carcinomata, the frequency of tonsillar cancer was exceeded only by those of the tongue, lip, and larynx, the percentage in the order named being 20.59, 15.39, and 12.17.

Because of the rôle the tonsils play in the infectious processes, we are apt to regard them merely as collections of lymphoid tissue. A brief review of the histology of the tonsil will show that epithelium constitutes a relatively large surface in the tonsillar region.

The lymphoid tissue of the tonsil is covered by the tunica mucosa, which consists of the tunica propria and the membrana propria. This epithelium is stratified epithelium of many layers, with flattened cells on the free surface and columnar cells beneath. The stratified epithelium serves as

a lining to a varying number of macroscopic depressions, usually 10 to 20, which are the crypts. These are irregularly tubular and are sometimes branched. This epithelial covering of the tonsil with its many foldings, together with the convex tonsillar pillar, constitute a relatively large area of epithelium though limited to a small region.

The exact etiology of carcinoma of the tonsil is unknown. If the theory of mal-development in the embryonic stage has any relation to the production of cancer, then it can be especially true of the tonsillar lesions, for in this region there is a complication association, in the embryo, of the hypoblastic and epiblastic tissues, pouching in to form the oral cavity.

The location of the tonsils is such that they are constantly subjected to irritation, by the constant motion of the jaws in speaking and eating, by thermal irritation consequent upon very hot foods, by smoking, and by the bacterial infections, which are more or less constantly present in the tonsillar crypts.

It is thought by some that cancer occurs only in tissue undergoing retrograde changes. Tonsils serve their greatest function in early life, and then usually show signs of progressive atrophy. Any one, or any combination, of these factors may be considered an exciting agent of tonsillar carcinoma.

There is no pathognomonic symptom of carcinoma of the tonsil. The most common symptom is pain, especially on swallowing. But this dis-

Preparation on Admission This is very important if a cesarean section is anticipated even though the patient may not be in labor. If labor is prolonged the instillations should be repeated every 12 hours. If the membranes are ruptured and the patient is considered potentially infected on admission before it is endeavored to do a cesarean section a catheter should be passed into the uterus above the presenting part and 3 ounces of a 1 per cent solution of mercuriochrome instilled into the uterine cavity. Following the cesarean section and immediately upon the removal of the placenta, before the uterine cavity fills with blood.

Outcome of a 4 per cent solution of mercurochrome is poured into the uterine cavity and allowed to drain out through the cervix and vagina. The mercurochrome solution should not be allowed to flow into the abdominal cavity. Any spill should be absorbed by sponges. When the fascia of the abdominal wall is closed the wound is sealed with mercurochrome care being taken that no excess solution is left in the wound. A uterine pack saturated with mercurochrome may be left in the uterine cavity.

Postoperative care. The perineum is sprayed at least once daily with a 4 per cent aqueous solution of mercurochrome. If there is a bad laceration of the perineum a previous vaginitis or if the patient is a poor obstetric risk, the vagina should be instilled daily with 2 drams of a 4 per cent solution of mercurochrome. This may be done with a small vaginal syringe similar to the one illustrated in Figure 2, or by means of a catheter attached to a small syringe. This procedure has been made routine by Dr Coodall of Canada and Dr Hagstrom of the Methodist Episcopal Hospital, Brooklyn, New York.

Preparation on Admision The patient is admitted to the hospital the perineum should be prepared and the vagina is filled as in Preparation on Admission. This should be done at least 1 hour before the operation. The preparation at the time of the operation should be as in Preparation for Delivery. All clots and blood should be removed from the vagina being left as dry as possible. The vagina is then filled with mercurochrome. The cervix is exposed and swabbed out with a sterile sponge or narrow strip of pack saturated with mercurochrome. A strip of packing also saturated

rated with mercurochrome is passed into the uterus. A small aseptic syringe containing 2 drams of mercurochrome may now be used to fill the uterine cavity with mercurochrome. Care should be taken when instilling the uterus. If the uterine cavity is small I have used a 2 cubic centimeter Luer syringe filled with mercurochrome and feel that this is sufficient. It is possible to force the mercurochrome through the tubes as was done in one case in which I did a laparotomy following a dilatation and curettage. If there is a rupture of the uterus the mercurochrome may escape into the peritoneal cavity. This is not desirable and may cause some discomfort following the operation. The uterus may again be instilled following the operation as mentioned before or if it is decided to pack the uterus a vaginal tampon saturated with mercurochrome may be used. This packing may be left in for 24 or 48 hours.

SUMMARY

- 1 All previous reports on the morbidity following the mercurochrome technique have included the cases delivered during the experimental stage.
- 2 The morbidity in 5076 vaginal deliveries during the development of the mercurochrome technique was 8.9 per cent and with 5203 cases with the present technique it was 5.6 per cent. This is compared with 2072 cases before the use of mercurochrome with a morbidity of 12.4 per cent.
- 3 A history of the development and an outline of the mercurochrome technique year by year is given with the resulting morbidity.
- 4 The average daily morbidity per patient was 0.40 before the use of mercurochrome, 0.46 during the experimental stage and with the present directions carefully followed out 0.26.
- 5 Without mercurochrome 1 patient in every 345 had a morbidity of over 20 days. In the experimental stage it was 1 in 39, while in the latest group it was 1 in 78.
- 6 The season of the year has very little to do with morbidity when thorough vaginal antiseptics are used.
- 7 The corrected morbidity for the last 52 cases was 3.01 per cent.

CONCLU ID \$

A 6 year study of vaginal antiseptics in hospital cases at the Methodist Episcopal Hospital and the resulting morbidity following 10000 deliveries with the mercurochrome technique seems to have proved that it is possible to protect almost every mother from the ravages of puerperal infection.

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carcinoma of the tonsil Following the destruction of the primary growth by the cautery or diathermy, the patients have died of metastases

This brief résumé should be sufficient to compel anyone to classify carcinoma of the tonsil in any stage as primarily surgically inoperable

CLINICAL STUDY

It is my purpose to report a clinical study of 122 histologically proved cases of carcinoma of the tonsil admitted to the Memorial Hospital between the years 1921 and 1928, inclusive

The average age in this series was 55.4 years. The two extremes were 78 and 21 years. The patient 78 years old had a papillary growth, grade I, radioresistant. The youngest patient, 21 years of age, had a transitional cell type carcinoma, grade III, radiosensitive. In the latter case there was bilateral cervical involvement. For 9 months patient had noticed a swelling in his neck, which had been incised before he applied to the hospital for treatment.

It is of no practical importance whether the lesion is on the right or the left side. In this series, the right and left sides were almost equally involved. 52 lesions were on the right side, and 69 were on the left side.

Since carcinoma of the tonsil is never a primarily operable disease, it cannot be classified into operable and inoperable, or into early, borderline, and advanced, which is a surgical nomenclature and refers to surgical technique rather than to prognosis. In this communication, the carcinomata will be classified as early or advanced. By early is meant that the lesion involves only one, or at most, two contiguous regions, that is, tonsil and tonsillar pillar, or tonsillar pillar and adjacent tongue, etc. If three regions are involved, or wide extension into an adjacent region is found, then the case is advanced. It is not uncommon to have a cancer of the tonsil infiltrate the base of the tongue to a point near the opposite tonsil. In one patient in this series a growth of the tonsil had so deeply infiltrated the mucosa of the cheek that there was marked trismus, due to infiltration of the masseter muscle by the neoplasm.

Of the 122 cases studied, only 33 were classified as early, while 88 were advanced. Two patients had had a tonsillectomy before admission, so were classified as early, and one chart was deficient in its description, although the diagnosis was verified both historically and histologically.

Several cases were classified as early though cervical metastases were present. The reason for this classification is to emphasize the fact that

insignificant primary lesions can give rise to metastases.

If only those cases were considered early, in which the primary lesion was limited to two regions, and at the same time showed no neck involvement, the total would be 14, or 11.5 per cent.

The gradations, as determined by the histological study, of the sections of the 117 classified cases, were as follows:

	Cases	Per cent
Grade I	10	8.5
Grade II	88	75.2
Grade III	8	6.9
Transitional	11	9.4

In 4 cases the section was so small it could not be graded, and one was a mixed grade II and transitional cell carcinoma.

These figures at first sight would seem to be at slight variance with those given by Ewing in his classification of 200 tonsillar lesions. But if the grade III group, which has lost its squamous characteristics, is combined with the transitional cell group, and the single case of mixed type added, then, within a small percentage, the figures agree with his total of 72 per cent squamous and 18 per cent lympho-epithelioma and transitional cell carcinoma.

There is much to be learned by the histological study of very early lesions of the tonsil. If the tissue removed by tonsillectomy were carefully sectioned and microscopically studied, we would eventually learn much about the beginning of carcinoma primary in the tonsil itself. The exact location and the mode of origin are not now known.

The treatment of carcinoma of the tonsil is usually a combination of external and interstitial radiation. Each side of the neck is subjected to high voltage X-ray, the beam including both the primary lesion and the lymph drainage areas. Immediately following these exposures, the radium pack is directed over the primary lesion and the adjacent cervical region. These radiations are given in full erythema dosage. This amount of radiation delivers 150 per cent to 180 per cent of a skin erythema dosage to the tonsillar growth. With the histological gradation and the clinical response to the external radiation as a basis for judging the radiosensitivity, a varying amount of radon is then implanted into the neoplasm, depending on its size and the configuration.

The number of patients who apply for treatment with cervical metastases already definitely established, and often in the advanced stage, calls for a more vigorous education of the public re-

comfort accompanies so many oral lesions that it invites a thorough oral examination even though the patient is only a child. Carcinoma of the tonsil has occurred in children under 5 years of age. At times the patient complains of an irritation or soreness of the throat and occasionally of pain referred to the side of the head. Irritation and soreness indicate that the primary lesion is not widespread over the contiguous regions. If the pain referred to the side of the head is a prominent symptom it will be found that the lesion infiltrates deeply and that there is considerable extension into the base of the tongue or the esophagus. An obvious mass in the upper cervical region which has infiltrated around the upper branches of the cervical nerves

A painless mass in the upper cervical region or overlying the carotid bulb may be a metastasis from an apparently insignificant cancer of the tonsil. This manifestation is commonly associated with a lesion of the transitional cell type. It is not infrequent to have the patient apply at the hospital for treatment after such a mass has been incised by a physician who after a casual glance into the mouth has opened an abscess only to drain blood. This procedure tends to spread metastases and at times permits the growth to fungate through the wound.

The diagnosis of a cancer of the tonsil is not always simple. A microscopic section is sometimes necessary for a final decision. A classic description of a carcinoma of the tonsil is impossible; the sites of origin differ; the extent varies; there are different degrees of ulceration, bulk, infiltration and especially a variable amount of infection which alters the appearance.

The more usual type of tonsillar lesion might be described as an ulcerated growth of variable size involving the tonsil and tonsillar pillar commonly the anterior. The edges of the ulcer are elevated, indurated, irregular. The indentation may extend into the tongue in such case there is a fissure between the tonsillar pillar and the tongue. The floor of the mouth and the mucosa of the cheek are the next most likely places to be involved. The ulcer may present the appearance of a coarse granular surface or a sloughy infected crater of the intermediate stages.

The radiosensitive non-ulcerating type of cancer may be confused with lymphosarcoma and the cervical metastases from a very small but radiosensitive carcinoma of the tonsil may be simulated by cervical Hodgkin's disease. The distribution of the adenopathy is helpful in differentiating carcinoma from Hodgkin's disease; in the latter the adenopathy usually general

But the lymph node enlargement is of little value in differentiating tonsillar cancer from lymphosarcoma. In either case the tonsil may be enlarged and a mass may be felt in the cervical region. A radiosensitive tonsillar carcinoma often lacks the characteristic induration which is frequently considered necessary for a diagnosis of cancer.

Assistance in the differential diagnosis of carcinoma and leuk or tuberculous ulcer may be had by the Wassermann reaction and X-ray films of the chest. But it must be borne in mind that either leuk or tuberculosis or both may be co-existent with carcinoma. Diagnosis of carcinoma of the tonsil must never be made on clinical examination alone; a histological study of a section is necessary in every case, primarily for verification of clinical diagnosis but also to classify the growth according to gradation of malignancy.

The region of the tonsillar pillar is not a rare site for an adenocystic carcinoma. The lesion can often be distinguished clinically by its lack of ulceration and its consistence which is that of encapsulated fluid under tension.

It is not necessary to mention the rarer types of tonsillar neoplasms because the diagnosis necessarily depends on biopsy.

In the literature on tumors of the tonsil (and these are reports of one or at most a few cases) tonsillar sarcoma is often mentioned and described. The more common description is a non-ulcerated tumor with the appearance of encapsulation. The mode of metastasis is said to be the same as in carcinoma and this extension occurs early. These so-called sarcomata are undoubtedly carcinomata of the transitional cell type or the lymphoepithelioma as described by Schmincke, Regaud and Erling. Sarcoma of the tonsil other than lymphosarcoma which belongs to the lymphoma group is rare. Pack and LeFevre did not find a case recorded in the study of 199 cases admitted to the Memorial Hospital.

The surgical approach in the case of carcinoma of the tonsil has been most inadequate. Cheever of Boston was the first in this country to describe the surgical treatment by a lateral pharyngotomy. This was in 1870. Matthews (1912) did not have a cure in 22 cases. His treatment was tonsillectomy and cautery or excision of the growth by a lateral pharyngotomy. This latter procedure was attended by a very high mortality; 4 operative deaths in 35 reported cases. 3 others died within 6 months. Only 4 patients lived beyond a year period. Jacobson (1901) reported one patient free of disease 1 year after tonsillectomy and cautery. Bloodgood in one of the latest statistics of surgery states that he has not cured a case of

TABLE II—1921 TO 1924 NO NODES ON ADMISSION		When	Operation

26 Early

garding the dangers of any oral lesion. This education might better be directed toward the medical profession, many members of which are often satisfied to give an alkaline mouth wash or simply paint the affected tonsil with silver nitrate. The patient is then told to return at a future date. Many of the advanced cases are the result of such a procedure.

Of the 122 cases studied in this series, 54.1 per cent, had no palpable metastases and 41.8 per cent, had no palpable metastases admitted for treatment. Thirty-seven, or 30.3 per cent, had surgically operable cervical metastases and 34, or 28 per cent, presented themselves with the disease had so far progressed in the cervical region that surgical dissection would have been impossible.

TABLE I.—COMPOSITE CHART OF ALL TONSILLAR CARCINOMA CASES TREATED FROM 1921 TO 1928 INCLUSIVE

V _d ages	Ave ge d m	Loc	E l d	P b l p al g d				C d res al p dimus			Es da	Nodal d	Local ur ce	L g	Local dis- rec L	Com ite ck rec L	H m b	A ge d f b	A f d g	N il er s
				I	II	III	T	N odes	Op bl des	I p er bl des										
T 1	3 A	1 ^{ph}	6 ¹ d ed						3	5	II M m m	5	6					7 mos		
	3	1 ^{ph}	Arf d d	3	p	h d					II m m 6		7					6 mos		
	3	3 1 ^{ph}	Arf d d	3	pe	h d			3		II m m 8		8					6 mos		
	3 B	1 ^{ph}	1 ¹ d d	3	6				6	5	II m m 6		3 ^{er}		8	6	1/2 mos			
5	5 B	1 ^{ph}	6 ¹ d ed								II m m		3					mos		
	5 B	1 ^{ph}	6 ¹ d ed	3	pe	h d			7		II m m 8		6					mos		
	5 B	1 ^{ph}	Arf d d	3	max d	II ₁ d			3	7	II m m							mos		
	5	6 1 ^{ph}	Arf d d	3					5		II m m		6					mos		
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TABLE IV—1921 TO 1924 OPERABLE NODES ON ADMISSION

	Primary	Grade	Recurrence	Location of nodes	Operation	Recurrence in neck	Result
1921 1	Early	II	o	Deep cervical	Ligature and bare seeds	o	Died 3 mos hæmorrhage
2	Early	II	o	Upper deep cervical	Carotid dissection	o	Died 6 mos hæmorrhage
3	Early	II	o	Upper deep cervical	Carotid dissection	o	Lost 5 yrs No evidence of disease
4	Advanced	I	o	Upper deep cervical	Carotid dissection	o	Died 6 mos hæmorrhage
5	Advanced	III Transit	o	Upper deep cervical	Carotid dissection	o	Died 10 mos
1922 6	Advanced	II	Tongue 3 mos	Upper deep cervical	Excision of node and bare seeds	o	Died 9 mos
7	Advanced	II	o	Upper deep cervical	Incomplete dissection	o	Died 5 yrs Tuberculosis no carcinoma
8	Advanced	II	o	Upper deep cervical	Excision at ligation	o	Died 2 mos Pneumonia at age 81
1923 9	Advanced	II	Primary not controlled	Upper deep cervical	Incomplete dissection	o	Died 3 mos
10	Advanced	Transit	o	Upper deep cervical	o	o	Well 7 yrs
1924 11	Early	III Transit	o	Upper deep cervical	Dissection incomplete and bare seeds		Died 6 mos
12	Advanced	III Transit	o Recurred in left upper quadrant 1 yr 5 mos	Upper deep cervical	Dissection complete and bare seeds	o	Died 19 mos
13	Advanced	Transit	o	Carotid region	Dissection incomplete	o	Well 5½ yrs
14	Early	II	o	Deep cervical	Dissection complete	o	Well 7½ yrs
15	Advanced	II	Primary not controlled	Upper deep cervical	Incomplete dissection	o	Died 5 mos

sides of the neck were involved 8 times, 9.5 per cent. It is interesting to note that following a ligation of the carotid artery and its branches, a neoplastic deposit was found in the scar once.

The treatment of the cervical region in carcinoma of the tonsil is the same as in cancer in other locations of the oral cavity. Only a very brief résumé will be made in this treatise. The conservative treatment of the cervical region has been maintained. On admission to the hospital service, the lymph drainage areas of the neck are irradiated with radium or X-ray or both. The site of the primary lesion is included in the beam of rays. This procedure is followed whether or not there is definite manifestation of disease in the neck. At the completion of this external radiation, gold tubes of radon are implanted into the primary growth. If there are no cervical metastases present at the time of admission, the patient is observed carefully and at frequent intervals, with special attention to the neck. If operable cervical metastases develop, or if they are present at the time of admission, a neck dissection is done when the skin reaction from the external radiation has subsided and the primary lesion is about

healed. The time for this to obtain is usually 3 to 6 weeks.

Cervical nodes to be classified as operable must be limited to the same side of the neck as the primary lesion, the carcinoma must not have infiltrated the capsule, and the gradation of the lesion must be in the more fully differentiated class histologically.

When a dissection is indicated, a full and complete operation is done, including the anterior and posterior triangles, with resection of the sternomastoid muscle and the jugular vein. If the primary growth is of a very radiosensitive type, radical surgery of the nodes is not undertaken, dependence is placed upon the surgical exposure of the node and radon in full dosage implanted in gold tubes. In the more advanced cases, the interstitial radiation is buried through the skin without incision. This latter method is used in advanced inoperable cases, if the type of cell of the neoplasm is radiosensitive or radioresistant.

Only in rare instances can "cross" metastases or bilateral metastases be considered operable.

In evaluating the efficacy of external radiation, it will be more enlightening to compare the group

TABLE III—1925 TO 1928 NO NODES ON ADMISSION

	Primary	G d	R cu en	D m l p-f des	Wh	Wh	Ope	Result
2	Ad d	II						W 11 55 mos.
	Ea l	II						W 11 6 mos
3	Ad d	II	Al eole edge 8 m	+	Upe deep rvl 1	mos	Disee in le	D ed os
4	Ea l	II	Base l to gu 6 mos	+	S bmaxillary 8	mos		D d mos
5	Advan d	II						W 11 6 m
6	Advan d	II	Base l to gu mo	+	Upper deep cervical	m	Com l te dissectio	W 11 44 mos.
	Ad d	II	Base l to gu m —also rs —5 mos					Los mos. Gang bed
8	Ea l	G d II d	T 13 mos Base l to gu 7 m	+	Upper deep cervical Post an l	3 yrs. yrs 5 mos.		D d 8 mos.
9	Ad d	II						D d os cause?
	Ad d	I	Never 11 d					D d 14 mos
	Early	II	loc lly esoph gu mos					D d mos Carcinom esophagus and left lva.
9	Ad ed	I ubh to gr d b car in ma						W 11 3 mos.
3	Adv d	II		+				Died 3 mos
	Ad anced	II						D d mos N t care ota mental ase
2	Advan ed	II						W 11 35 mos.
6	Ad d	II	T 1 gu mo 7 gu mos	I flammatory			Disee to	Lo yr mos N dis disease
7	Adva d	II						Well mos
8	Adva ced	II	T gu mos	Inflammatory			Disee to	D ed—esophagus carcinoma mos.
9	Adv d	II		+	U per d p cerv cal	mos	I per hl	D d 5 m
	Adva ed	II	T 1 fph rv cal all mos	Inflammatory			D se	Died mos
	Ea l	II		Inflammatory			Disee to	Well 8 mos.
	Ad d	II						Died mos. Hemorrhage
	E ly	II						W 11 m
	Advan d	T						W 11 mos
5	Ad ed	II	Al eolar dg	+	U pe deep rv	5 mos		D ed mos

Ninety one patients were admitted to the hospital with cervical metastases or later developed them. The location of these metastases was in the upper deep cervical group in 58 instances 63.7 per cent. The node overlying the carotid bulb was first affected 12 times and the node in

the posterior submaxillary region 6 times 13.2 and 6.6 per cent respectively. The opposite side to the primary lesion was first palpably involved in 3 instances 3.3 per cent. This same number of times the whole chain of nodes on the side of the primary lesion was palpably invaded. Both

TABLE IV—1921 TO 1924 OPERABLE NODES ON ADMISSION

	Primary	Grade	Recurrence	Location of nodes	Operation	Recurrence in neck	Result
1921 1	Early	II	o	Deep cervical	Ligature and bare seeds	o	Died 3 mos. hemorrhage
2	Early	II	o	Upper deep cervical	Carotid dissection	o	Died 6 mos hemorrhage
3	Early	II	o	Upper deep cervical	Carotid dissection	o	Lost 5 yrs No evidence of disease
4	Advanced	I	o	Upper deep cervical	Carotid dissection	o	Died 6 mos hemorrhage
5	Advanced	III Transit	o	Upper deep cervical	Carotid dissection	o	Died 10 mos
1922 6	Advanced	II	Tongue 3 mos	Upper deep cervical	Excision of node and bare seeds	o	Died 9 mos
7	Advanced	II	o	Upper deep cervical	Incomplete dissection	o	Died 5 yrs Tuberculosis no carcinoma
8	Advanced	II	o	Upper deep cervical	Excision at ligation	o	Died 2 mos Pneumonia at age 51
1923 9	Advanced	II	Primary not controlled	Upper deep cervical	Incomplete dissection	o	Died 3 mos
10	Advanced	Transit	o	Upper deep cervical	o	o	Well 7 yrs
1924 11	Early	III Transit	o	Upper deep cervical	Dissection incomplete and bare seeds		Died 6 mos
12	Advanced	III Transit	o Recurred in left upper quadrant 1 yr 5 mos	Upper deep cervical	Dissection complete and bare seeds	o	Died 19 mos
13	Advanced	Transit	o	Carotid region	Dissection incomplete	o	Well 5 $\frac{1}{2}$ yrs
14	Early	II	o	Deep cervical	Dissection complete	o	Well 7 $\frac{1}{4}$ yrs
15	Advanced	II	Primary not controlled	Upper deep cervical	Incomplete dissection	o	Died 5 mos

sides of the neck were involved 8 times, 9.5 per cent. It is interesting to note that following a ligation of the carotid artery and its branches, a neoplastic deposit was found in the scar once.

The treatment of the cervical region in carcinoma of the tonsil is the same as in cancer in other locations of the oral cavity. Only a very brief résumé will be made in this treatise. The conservative treatment of the cervical region has been maintained. On admission to the hospital service, the lymph drainage areas of the neck are irradiated with radium or X-ray or both. The site of the primary lesion is included in the beam of rays. This procedure is followed whether or not there is definite manifestation of disease in the neck. At the completion of this external radiation, gold tubes of radon are implanted into the primary growth. If there are no cervical metastases present at the time of admission, the patient is observed carefully and at frequent intervals, with special attention to the neck. If operable cervical metastases develop, or if they are present at the time of admission, a neck dissection is done when the skin reaction from the external radiation has subsided and the primary lesion is about

healed. The time for this to obtain is usually 3 to 6 weeks.

Cervical nodes to be classified as operable must be limited to the same side of the neck as the primary lesion, the carcinoma must not have infiltrated the capsule, and the gradation of the lesion must be in the more fully differentiated class histologically.

When a dissection is indicated, a full and complete operation is done, including the anterior and posterior triangles, with resection of the sternomastoid muscle and the jugular vein. If the primary growth is of a very radiosensitive type, radical surgery of the nodes is not undertaken, dependence is placed upon the surgical exposure of the node and radon in full dosage implanted in gold tubes. In the more advanced cases, the interstitial radiation is buried through the skin without incision. This latter method is used in advanced inoperable cases, if the type of cell of the neoplasm is radiosensitive or radioresistant.

Only in rare instances can "cross" metastases or bilateral metastases be considered operable.

In evaluating the efficacy of external radiation, it will be more enlightening to compare the group

SURGERY GYNECOLOGY AND OBSTETRICS

TABLE V.—1925 TO 1928 OPERABLE NODES ON ADMISSION

P m ry	G f	R ur	Loc tio l des	Ope	Recu en	R al
Ea l	II		U pe d cerv al			
Ad d	II	Sol pal te	U per d rn l			D ed 5 mos
Ea l	III		U pe deep rn l			D d 6 mos
Ad d	II	A mos	U d vic l		Opposi l	D d 3 yrs 8 mos
Ad d	II		U d bmaxill ry	R fused		Los yr mos
6	Ad l	II	U pe dee rn l	D issectio mpl te	U d l yrs	D d 3 yrs on
7	Ad ed	I	Car d b lb	Ca d dissec		Died yr mos
6	Ad d	I	Pos submaxillary			D ed mos
8	Ad d	I	U d cervical	External distio pa t 8 yrs		D ed 6 mos
Ea l	II	T nra m un tr ll d	Car d bulb	Dise tio m l te	\$ bmaxillary gion 5 mos	D d mos
Ea l	II	Ante so ul al mos	U dee vical	D issectio to on l		D d m. os. stomach
Ad d	III		U pe dee rn l			D ed 6 mos
Ad d	T		Car d b lb	E l d t to spor d		Los 9 mos N b disease
Ad l	II	Base l to gu m	C d b ll	D ise tio sh l	Scar 8 mos	D d os
Ad an l	II	N on, U d al d Onl	U per dee rv l	P en yrs		Died mos
Ad d	II		S bna dl ry	S b llar dissec		D ed mos lchd
6	Ad d	I	U pp dee cerv l d lary	U per eck disce	Oppo te ck mos	D ed yr mos
Ad l	II		C l	A so disce		Well yrs mos
Ad ed	II	U l f m	U pe deep rvical	Com l disce tio		D d yr on
Ad d	II		Ca d b lb	I m l d sac S bmaxill ry		W ll yr mos
Ad ce	II		U d rv l	Co le dissec tun	I os	D ed mos
Ad an d	I	U ul mos	U pe dee erv al	Co le dissectio		D ed 5 mos
A	II		U pe dee rvical	C m l d se	L on k	D ed mos

of cases f 92-194 in lus e and the goup 195-1928 inclus v. It was about 95 that the exte nal rad ation dosage was inc eased and later the 4 g am adium element pack was added to the hospital equ pment

Of the 26 cas s admitt dth t palpable nodes between 19 and 94 nclu e 3 pa tients or one half developed cer al metastases. But many of these d ed of unc nt oiled primary intercu rent d sease or hæm rrhage vth n too short a time to make a v o th while estimate. A bette evaluation even tho gh made n a sm llc number of ca es can be had by includi g nly

th se patients who lived 20 more years. There were o such cases. Of the e to o ly 3 or 33 pe cent developed cervical metastases

From 195 to 1928 there v e 25 p tients ad mitt d w thout cerv cal ade opathy. Eighteen o 7 per cent did not devel p mal gna t nodes of the n ck. Of the 13 patients living 20 m e y ars 3 ha e h d nvol ement of th cervical n de 23 pe cent

Comari g the two periods it is found that f om 92 to 194 m l sive 50 per cent of all cases remai ed free of regi nal metastase and 66 pe cent of those living y ears or more had

TABLE VI—1921 TO 1924 INOPERABLE NODES ON ADMISSION

	Primary	Grade	Location of mass	Treatment	Result
1921 1	Advanced	II	Confluent mass upper deep cervical	Partial removal and bare seeds	Lost 10 mos
	Early	II	Upper deep cervical	External radiation	Died 3 mos
1923 3	Advanced	II	Upper deep cervical infiltrating sternomastoid	External radiation and bare seeds	Died 17 mos
4	Advanced	II	Nodes both sides	External radiation and bare seeds both sides	Died 17 mos
5	Early	III Transit.	Upper deep cervical and submaxillary	External radiation	Died 6 mos
6	Advanced	II	Whole chain of nodes	External radiation bare seeds	Died 1 mo
1924 7	Advanced	III Transit	Upper deep cervical same side Carotid on opposite side	Bare seeds	Died 6 mos
8	Early	II	Upper deep cervical and submaxillary	External radiation and bare seeds at exposure	Well 5 yrs 2 mos

no evidence of cervical involvement During the period 1925 to 1928, inclusive, the respective percentages were 72 per cent and 77 per cent.

There is considerable percentage difference in the results in the two periods More adequate external radiation during the second period was undoubtedly a factor, but due consideration must be given to the use of gold tubes after the beginning of 1925 Gold tube implants of radon have been much more efficacious in the destruction of the primary growth than the glass seeds While there is disease present, danger of metastases persists Recurrence is a manifestation of latent disease

The location and frequency of local recurrences were as follows tongue, 16 times, tonsil, 7, soft palate, 6, pharyngeal wall, 2, and floor of mouth and mucosa of the cheek, once each

During the period 1921 to 1924 there were 15 local recurrences, 30 per cent, whereas in the period 1925 to 1928 there were 18 local recurrences, 24 per cent This decrease in the percentage of local recurrences is primarily due to the use of gold tubes, this type of implant being first used at the beginning of 1925, the bare seeds were in use previous to that time

The reason for the decrease in recurrences will be obvious if the quality of the radiation from the two types of implants is considered If the amount of radiation transmitted by the glass seed is taken as 100 per cent, then the relative amounts of β rays and γ -rays are 96.5 per cent and 3.5 per cent, respectively With the 0.3 millimeter of gold filter, the β radiation is 8.8 per cent and the γ -radiation is 91.2 per cent, again assuming that the transmitted radiation is 100 per cent The total radiation transmitted by the gold tube is

only 3.16 per cent of that transmitted by the glass seed The 0.3 millimeter of gold screens out practically all the soft, necrosing β -rays, whose sphere of activity is limited to a region with a diameter less than a centimeter, but which, due to their quantity, produce total destruction of tissue in proximity to their source The usual amounts of radon in glass seeds and gold tubes are 1 millicurie and 2 millicuries, respectively In the comparison of these two implants, it is found that the glass seed of 1 millicurie produces five times the volume tissue necrosis as the gold tube of 2 millicuries In other words, twice the amount of γ -radiation may be had from gold implants, with one-fifth the volume necrosis produced by glass seeds Hence more equal distribution of radiation is delivered throughout the tumor bearing area

The complete necrosis around the implant was a great difficulty in the care of patients treated with glass seeds of radon The slough became an excellent culture medium for bacteria, and the infection added to the slough The average duration of the presence of the slough following the use of glass seeds was 5.4 months This average was reduced by using gold tubes to 2 months Many of the patients having had gold tube implantation into the tonsillar region had no slough at any time The average was brought up to 2 months either by the presence of infection due to poor oral hygiene or by the necessity for further treatment of a persistent portion of the disease or a recurrence These conditions are essentially the same, only the time interval suggests the distinction The second implantation of radon even in gold filtered tubes, nearly always causes a secondary necrosis

TABLE VII—1925 TO 1928 INOPERABLE NODES ON ADMISSION

	P m ry	G d	Loc f mass	T estm	Result
95	Advan d	I	Ag f w d er d b lb	Ex er al distio and g ld b	Los 8 mos. don badly
	Ad an ed	II	Opposite d I k	Gold t bes f ll d by disse	D d mos.
	Earl	III	B th des I eck	Gold t bes	D d os
	Advan ed	II	U pe d ep erv al	Ex ter t dia	D ed 8 mos
5	Ad an ed	II	Uppr dee erv al	External adition	D d y
6	Ad ced	?	Deep ern I l fl tes m sel and	Ex er al dia d g ld bes	D ed mos.
7	Ad an d	III	B th des f k	Exter al adia gold t bes b d	Died mos
8	Early	II	Car d g g m	Exter l adition	D ed mos.
9	Ad d	III	Upper eck g	External dia	D ed mos.
7	Ad d	II	Dee ern al both des	External dia	D ed os
	Ad an d	?	Upper cervical 8 6 m.	Exter l dition	Died 8 os.
	Ad d	III	B th des	External radi tio	D d mos. with biolmal metastas
	Ad d	I	Sam de—wh l ban	Ex er l d	D d yr mos
4	T le tom ber	III	Upper deep erv cal lall masto d 3 m.	Ex er l d on 8 oco 6	D d yr 6 mos
	Earl	III	Upper deep cervical	Exter l dition and gold bes	W ll yrs. mos
6	Ear	II	Upper deep cervical	Gold bes d ex er al adition	Died os
8	Ad ced	II	Upper deep erv al	Ex t f dia d ld tubes	D d mos 6 mo lapp
8	Adva ed	II	Car d epion	Ex er l dia and ld tube	D ed yr os. D ed 10 mos. of pharyngeal all
	Ad anced	II	Oppou pper de erv al	Ex er al dia	D d 3 mos. hemorrhage
	Cervical enure	II	Opposite ar d go	Ex er al adition d g ld bes	Died 6 mos
	Adva ed B th t	II	R h l f j L car d g	Ex er l d ho d gold bes	D d mos
	Ad d	II	D p v l 5 m	Ex er l adia	D d mos
	Ad d	III	Deep erv cal 8 8 cm	Ex er al h d g ld b	D ed yr mos
	Ad ed	III	B h ld	Ex er l dia d g ld b	D d yr os
3	Ad d	II	Dee erv al	Ex er al dia	Died mo
6	Ad d	II	Uppr dee ern I	Ex er l dia	D d mos.

Consequent upon the necrosis and the separation of the slough hæmorrhage occurs. The region of the tonsil has an abundant blood supply and the inaccessibility precludes the possibility of tamponage which in this general obstruction the breathing. Ligation of the external lingual and facial arteries is the only procedure at all adequate to control the hæmorrhage this suffices only if the bleeding arterial is less efficacious if the hæmorrhage is venous.

During the period that the glass eads were in use ligation was done in 50 per cent of the cases

and the external 4 per cent of the patients who had hæmorrhage. Following the advent of the gold tubes a ligation was done in 8 per cent of the patients and bleeding occurred in 15 per cent. These figures do not adequately describe the improvement in the technique because the severity of the bleeding has been markedly decreased.

Sufficient time has not elapsed to study the 5 year results in those cases treated with gold tubes. The publication of the statistical study includes only the tonsillar carcinomata treated previous to 1923.

The data for hæmorrhage per coll d

and with bare seeds There were 49 cases in this group and 10 survived the 5 year period, a percentage of 20.4 per cent One patient was lost just at the 5 year interval He was free of disease, and if included in the 5 year cases, the percentage would be 22.4 per cent

If the patients are grouped according to the condition of the cervical nodes, 5, or 38.4 per cent, of the 13 cases with no nodes throughout their period of observation, are well No patient as well who entered the hospital without nodes, but later developed them after admission There were 13 such cases Of those 15 patients who had palpable metastases but in an operable stage on entrance to the hospital, 4 patients, or 26.6 per cent, survived the 5 year period In the inoperable group, 1, or 12.5 per cent, is clinically free of disease at the end of 5 years and 2 months This patient had a grade II lesion, with the upper deep cervical group of nodes involved Following the regression of the primary lesion and dissection of the anterior triangles of the neck, with removal of the sternomastoid muscle and the jugular vein, metastases appeared in the posterior triangle of the neck Since the primary lesion had completely regressed, this manifestation of disease was undoubtedly present, but not discernible, at the time of operation, therefore it is classed in the inoperable group because of the wide dissemination However, this classification may be questioned The nodes in the posterior triangle were implanted with radon in glass seeds

Whichever way this case is classified, the 20.4 per cent clinically free of disease at the end of 5 years remains the same

SUMMARY

Carcinoma of the tonsil is not a rare disease, it comprises 2.23 per cent of all the malignant tumors admitted to the Memorial Hospital, and 9.64 per cent of the intra-oral malignant tumors

Surgery alone is totally inadequate to cope with this disease

Most carcinomata of the tonsil are advanced when first seen in the hospital clinic

The size of the primary growth has no relation to the stage of the disease as judged by the metastases

More adequate external radiation and the use of gold filtered tubes of radon have made radiation therapy more efficacious

(The grade II type of carcinoma was the preponderant lesion—88 or 75.2 per cent)

Of the 122 cases in this series, only 51, or 41.8 per cent, were admitted without cervical metastases Only those patients treated up to

TABLE VIII—CASES WITH NO NODES ON ADMISSION, EXTERNAL RADIATION GIVEN AND THE SUBSEQUENT DEVELOPMENTS

Primary lesion	Grade	Radiation	Developed nodes	When	Result
1921					
Early	II	Minimum	o		Well 8 1/2 yrs
Advanced	II	Minimum	o		Died 5 mos
?	II	Minimum	+	3 mos	Died 10 mo
Early	II	Minimum	o		Died 2 mos
Advanced	II	Minimum	o		Died 8 mos*
Advanced	I	Minimum	+	6 mos	Died 17 mo
Advanced	II	Minimum	+	1 mo	Died 2 mos
Advanced	II	Minimum	o		Well 9 yrs
1922					
Advanced	II	Minimum	+	2 mos	Died 4 mos
Advanced	II	Minimum	+	5 mos	Died 17 mos
Advanced	II	None	+		Died 7 mos
Early	?	None	+	7 mos	Died 33 mos
Early	II	Minimum	+	1 mo	Died 18 mos
Early	II	None	+	9 mos	Died 10 mos
Advanced	I	Minimum	o		Died 34 mos†
1923					
Early	II	Good	+	1 mo	Died 18 mos
Advanced	II	Minimum	+	14 mos	Died 16 mos
Advanced	II	Minimum	+		Died 2 mos†
Early	II	Minimum	+		Lost 15 mos‡
Advanced	II	Minimum	+		Died 8 mo†
Advanced	II	Minimum	+		Well 7 1/2 yrs
Advanced	II	Minimum	+		Well 7 1/2 yrs
Advanced	?	Minimum	+		Well 7 1/2 yrs
1924					
Early	II	Minimum	+	36 mos	Died 30 mos**
Advanced	II	Fair	+	6 mos	Died 14 mos
Early	III	Fair	+	3 mos	Died 7 mos
1925					
Early	II	Good	o		Well 55 mos
Early	II	Fair	o		Well 56 mos
Advanced	II	Fair	+	2 mos	Died 12 mos
Early	II	Minimum	+		Died 70 mos
Advanced	II	Good	+		Well 56 mos
1926					
Advanced	II	Good	+	1 mo	Well 44 mos
Advanced	II	Fair	+		Lost 9 mos
					Going bad
Early	II	Fair	+	36 mos	Died 38 mos
Advanced	II	Fair	+	Lost	Died 13 mo
Advanced	I	Fair	+		Died 3 mos
Early	II	Good	+		Died 4 mos
Advanced	?	Good	+		Well 5+ mos
1927					
Advanced	II	Fair	+	2 mos	Died 3 mos
Advanced	II	Fair	+		Died 17 mos***
Advanced	II	Fair	+		Died 36 mos
1928					
Advanced	II	Fair	o		Well 29 mos
Advanced	II	Good	o		Died 20 mos
Advanced	II	Fair	+	6 mos	Died 16 mos
Advanced	II	Fair	+		Died 13 mos
Early	II	Good	+		Well 28 mos
Advanced	II	Fair	+		Died 7 mos
Early	II	Fair	+		Well 70 mos
Advanced	Transl.	Good	+		Well 30 mos
Advanced	II	Good	+	5 mos	Died 37 mos
Advanced	II	Good	+		Lost 22 mos‡

*Primary uncontrolled
 • Local recurrence 6 mo
 • Carcinoma of the oesophagus
 †Died not carcinoma
 ‡Pneumonia
 ‡Hemorrhage
 ‡No evidence of disease

1925 can be included in the 5 year group Of these 49 cases—13 had no cervical nodes throughout and 5, or 38.4 per cent, are well, 13 developed metastases after admission and none is well, 15

TABLE IV—DURATION OF LIFE AFTER ADMISSION

	N	f	0-6 mos	6 mos	y	y	y	y	f
Nodes bi ou h t	3		(1 h m m h a m a) m	- 3 ⁰⁰	- 7 ⁰⁰	- 1 ⁰⁰	-	-	30 ⁰⁰
D i p g d	3		- 0 ⁰⁰	- 0 ⁰⁰	6- 6 ⁰⁰	3- 3 ⁰⁰	- 3 ⁰⁰	-	-
Op bl des	5		- 3 ⁰⁰	1- 0 ⁰⁰	- 0 ⁰⁰	-	-	-	5
In pe bl odes	3		- 0 ⁰⁰	- 3 ⁰⁰	3- 0 ⁰⁰	-	-	-	3 ⁰⁰
TOTAL	4		- 0 ⁰⁰	- 0 ⁰⁰	- 0 ⁰⁰	3- 0 ⁰⁰	- 0 ⁰⁰	-	0-30
S S	N	f	0-6 mos	6 mos	y	y	y	y	f
N d th hou	1		- 0 ⁰⁰	- 6 ⁰⁰	- 0 ⁰⁰	- 6 ⁰⁰	-	-	0 ⁰⁰
Dev l d	21		- 0 ⁰⁰	-	- 3 ⁰⁰	- 0 ⁰⁰	-	-	-
Oper bl d	2		- 3 ⁰⁰	3- 6 ⁰⁰	6- 0 ⁰⁰	- 0 ⁰⁰	- 0 ⁰⁰	-	-
Inope bl od	54		- 0 ⁰⁰	- 38 ⁰⁰	3- 0 ⁰⁰	1- 3 ⁰⁰	-	-	-
TOTAL	73		- 3 ⁰⁰	- 6 ⁰⁰	- 0 ⁰⁰	- 0 ⁰⁰	- 3 ⁰⁰	-	-

† ase vid 3/ 3 3/ 3 3 3 3
 ‡ cases ev d 3/ 3 3/ 3 3 3 3
 † ase ev d 3/ 3 3/ 3 3 3 3

had operable nodes on admission and 4 or 25.6 per cent are well and 8 had inoperable nodes on admission and 1 or 12.5 per cent is well. In the group treated 5 or more years ago 10 patients are now clinically free of disease from 5 to 9 years a percentage of 20.4.

Carcinoma of the tonsil should be treated by radiation therapy or by radiation and surgery of certain metastases not by surgery alone.

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 du t r e b u f p l u d t th M e m o r i a l
 H o s p i t a l N w l C t y J C R e s c h 93
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 9 Q u D T m t f m a l i g t p l m f t h
 t n s l J R d o l 9 u 13 C r y t u t r e f
 m t f r y c a l l y m p h u c s m t r - o a l r c u n
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IT is a matter of every day experience that the timid or inadequate removal of the thyroid commonly gives but limited relief from symptoms and only partial control of the rate of metabolism. It is equally a matter of every day clinical experience and laboratory demonstration that total or subtotal removal of the normal or pathological thyroid results in varying degrees of hypothyroidism, closely related to the extent of thyroid removal.

In my own experience, the extent of the thyroidectomy has determined not only the degree of immediate relief, but the permanence of that relief. I have been able consistently to substitute hypothyroidism for hyperthyroidism in a series of cases, the data of which I will present to you. In the great majority of the patients the hypothyroidism ultimately gave way to normal thyroid activity with what I judged to be the development of a compensatory hyperplasia. Hypothyroidism, however, persisted in a sufficient number of these patients to present the only source of doubt as to the advisability of this radical procedure. That some failed to return to normal function and that those whose function returned to normal did not develop by a progressive increase in the thyroid function to above normal, that is, to relapse, I have attributed to sheer inability of the small amount of thyroid that I leave to develop such a relapse. The persistence of hypothyroidism in the human subject has its counterpart in the failure of adequate compensatory regeneration in the experimental animal in which the amount of residual thyroid is sufficiently reduced.

In comparing results of the radical operation which I propose with less radical procedures regarded by many as satisfactory, I have repeatedly stated that objective data based on observations for which the reporter can personally vouch, are alone of value.

The diagnosis of the patient's postoperative condition is just as important and requires the same type of study as the original diagnosis. Neither can be accomplished by correspondence. It requires no unusual clinical experience to learn that the subjective feeling of perfect well-being on the part of the patient may be associated with the most obvious objective evidence of persistent thyrotoxicosis. No answers to letters of inquiry

can have any diagnostic value that justifies their consideration.

As a justification for the very radical operation advocated in this paper, I wish to present in abstract the recent studies of two series of cases previously published. For this purpose data on the basal metabolic rate alone are presented because I believe they form the simplest and most accurate objective data available for comparative studies. It must be clearly understood, however, that not only were these metabolism studies made under my personal supervision, or the supervision of competent recognized internists, but that the patients were also personally examined under the same conditions. That is, the diagnosis of the postoperative condition was based upon exactly the same type of study as that on which the original pre-operative diagnosis was made. No data on the basal metabolic rate or reports on the condition of the patients made by their family physicians or by outlying laboratories or hospitals are included.

The statistical material is limited to patients who have been adequately studied, and whose basal metabolic rate generally was above +30. Plus thirty was arbitrarily chosen to safeguard against the inclusion of questionable border-line cases. Patients who were clinically toxic, but whose metabolic rate was not raised, or whose clinical data were insufficient, were separately classified and not included in this study. There were no deaths among these, so the mortality data are not favorably affected by excluding them. A certain number had received iodine preparation before coming under observation, where the clinical diagnosis was obvious, these were included. Relatively few were included with typical thyrotoxicosis of mild grade with consistently raised metabolic rate but not reaching +30. In all, 14.8 per cent were below +30.

The first series (1) concerned 112 consecutive patients of whom a personal postoperative study of 100 could be made. This series was studied in June, 1926, and published in March, 1927. At that time 99 of this 100 had normal or subnormal rates of metabolism, 5 after a secondary operation. Seventy-six of these patients have since been followed, 55, for over 5 years. Two hundred and thirty-eight additional metabolic rate readings have been made upon them. But one has been

found to be toxic. She was a child of 13 when operated upon; hence a less radical operation was done. She had but a single metabolic rate reading of $+6$ at the time of the original publication; then disappeared for 6 years. She now is mildly toxic ($+28$) and has palpable thyroid masses.

The second series was of 500 cases published in July 1929 (2). Of these 447 were available for postoperative study at the time of publication. Four hundred and forty-three of these had a basal metabolic rate of $+15$ or below; 3 of the 4 obviously were not toxic at the time their metabolic rate being accounted for in the paper as published. None of this series had required a second any operation.

Three hundred and fifty-four of the 447 patients have since been studied; 655 additional metabolic rate readings being made to date. Of these the patient who was toxic at the time of publication was subsequently reoperated upon. One had a single metabolic rate at the time of publication of $+3$. Subsequently she had two raised readings and was clinically toxic though her metabolic rate is now $+10$. One had an associated hemolytic jaundice at the time of operation. Her metabolic rate had not reached normal on the eighth postoperative day when she passed from under observation. She returned 4 months later in an acute exacerbation of her jaundice during which she died. Two metabolic rate readings taken during this exacerbation were $+20$ and $+23$. Fifteen of the 43 patients on whom we had no data at the time of publication returned for further study. Of these one who had regarded himself as well for 2 years as obviously toxic.

Thus of 600 patients subjected to ultraradical thyroidectomy the data on which have been published 559 have had some postoperative study. Of these 430 have been subjected to further studies including 900 additional metabolic rate readings. But of those reported no malady at the time of publication has since become manifest each after a single normal basal metabolic rate. One of these was the 3-year-old child mentioned whose operation was planned to be relatively conservative because of her youth. In not a single patient in this series whose basal metabolic rate was normal on two or more tests has there been a relapse of thyrotoxicosis with a rise of metabolic rate.

A further study of 500 additional patients subjected to thyroidectomy subsequent to these two series shows but a single patient mentioned below who after three normal basal metabolic rate readings showed a definite rise with the evidence of thyrotoxicosis. This is the only possible exception in

a series of 1100 cases in a patient whose metabolic tests were made at long intervals with practically no medical supervision during which he may very well have had periods of thyrotoxicosis. It is conceded that thyrotoxic patients not subjected to operation may have periods of quiescence certainly thyroidectomy even so incomplete may not prevent this. The very great number of conservative thyroidectomies that are followed by permanent benefit show how wide a latitude is permitted the surgeon.

To determine the nature of what is commonly described as a relapse a study was made of a series of 50 patients presenting themselves for secondary operation following failure of a previous thyroidectomy. Thirty-two had their first operation elsewhere; 18 by me. Most of these patients reported themselves as having been well for various periods of time following their original operation ranging from 8 months to 13 years. Forty-one of these patients had had no adequate medical supervision and no basal metabolic rate studies during their period of seeming well-being. Eight of these patients had been adequately studied clinically and with repeated metabolic rate observations. All 8 of these were found to have been consistently toxic throughout. Some had occasional normal or low metabolic rates especially while taking iodine—none had consistently normal rates at any time. These were all obvious failures and not relapses.

One patient mentioned had shown three normal readings and may possibly be recorded as a case of true relapse after operative cure but was not under adequate supervision and cannot be accurately classified. Thus of 50 unselected apparent relapses but one incompletely studied patient may have had a true relapse while 8 patients adequately studied proved to be cases of inadequate surgical surge.

Mortality. The ultraradical thyroidectomy in one sitting is planned not merely to lessen the incidence of immediate failure and late relapse of thyrotoxicosis but to lower mortality. The basic idea (3) is that not enough pathology is thereby left to permit a serious postoperative thyroid crisis. According to this conception it is precisely the most toxic patients, the poorest surgical patients who require the most radical operation and that at one sitting.

There was no death in each of the two series; a total of death in 6 cases a patient mortality of 3+ per cent.

In a study of results in older patients of the study that in a consecutive series of 1060 patients of whom 200 were over 50 years of age there were 6

deaths among the 200, and 3 deaths in 860 consecutive cases under 50 years of age, a total mortality of 0.85 per cent. The patients were not picked, their ages ranged to 76 years, and no patient whose consent could be obtained was rejected. Obviously, the mortality would have been further lowered by less rigid exclusion of clinically toxic patients on their basal metabolic rate findings.

THE ESSENTIAL FEATURES OF THE OPERATION

1 *Pre-operative* Iodine is given in large doses, well diluted, over a period of 2 to 4 weeks, longer in severe cases. Clinical gain rather than metabolic rate response determines the duration. My experience with small doses of iodine has been unsatisfactory. Medicinal preparation other than iodine and sedatives is left entirely to the internist. Except for special indications, patients are ambulatory and not hospitalized during this period, though long hours of rest and high caloric feeding is enforced.

2 The thyroidectomy is completed in one sitting. There are no preliminary ligations or lobectomies. The purpose is to leave so little thyroid behind that a postoperative reaction cannot develop.

3 The upper poles are so exposed as to permit the division of the superior thyroid arteries between clamps. These are the only vessels divided between clamps during the entire operation. No other vessel requires it. The poles themselves are never ligated—no part is ever left behind.

4 With the pole drawn downward the fascial tissue forming a sort of suspensory ligamentous structure supporting the upper border of the isthmus and containing a single small artery is made tense. A curved forceps is gently insinuated under it, toward the median line, a clamp is applied and it is divided.

5 The isthmus is divided and the parts retracted laterally by means of sharp retractors hooked into the tissue, thus everting the lobe. Usually but one artery, or none, crosses the isthmus and needs clamping—the retraction prevents venous bleeding. The large veins crossing over its surface may be disregarded if kept under gentle tension. The size of the isthmus has little bearing on its vascularity.

6 Sharp and dull dissection from the trachea permit the lobes to be further everted. A vascular tree can often be made out in the inner surface, and grasped with forceps, otherwise one, or in large lobes, two forceps are pushed into the thyroid tissue close to but not impinging on the trachea, and the lobe further dissected off and everted.

7 One or two forceps are now pushed into the lower pole close to the capsule, one or two into the outer aspect of the lobe parallel with the capsule, and one on the posterior aspect of the lobe near the upper pole, and the lobe is removed. Both lobes are treated alike. In the great majority of hyperplastic thyroids, a single forceps is placed on each superior thyroid artery and six or less, usually four or five, in each lobe. Often additional forceps or a suture are further applied after removal of the lobes—seldom more than two or three additional ligatures in all.

The larger nodular goiters commonly require more forceps merely because of anatomical distortion. If the forceps could be as correctly placed as in the symmetrical goiters, very few additional forceps would be required.

Care is taken to save as complete, but as thin a layer of posterior and mesial capsule as possible, for the protection of the nerves and parathyroids.

The thyroid tissue remaining is spread over a very thin layer. One can roughly estimate its dimensions in cubic centimeters and record the result in grams. I have gradually been reducing the amount so that it is now less than 2 grams, but I am inclined to leave more, probably 2 to 3 grams, because of the persistence of hypothyroidism in too many of my patients.

Since little thyroid is left behind, little or no postoperative iodine is required. I have recently reduced the postoperative use of iodine to a moderate dose the day of operation, little or none thereafter unless some reaction suggests that more than the estimated amount of thyroid has been left behind. Since most of these patients are temporarily hypothyroid, desiccated thyroid is started about 4 weeks after operation and given in varying doses, guided by the clinical symptoms and metabolism findings as long as may be necessary, usually several months to a year or more.

Immediate effect on the basal metabolic rate. Following this radical thyroidectomy the metabolic rate after an abrupt rise during the first 24 hours, falls rapidly to or below normal. In a series of cases studied by the Massachusetts General Hospital Goiter Group, the metabolic rate was found to reach normal in an average of 10 days. In my study, 21 consecutive patients were subjected to daily postoperative basal metabolic rate studies. In 20 of these the rate reached normal on or before the sixth day, averaging 4+ days. Of these patients, 9 were operated upon on a Monday, and all 9 had normal rates on Saturday, 7 of the 9 on Friday, an average of 3.55 days. Twelve were operated upon on Tuesday, no readings were made on Sunday, and 11 of the 12 were normal on

found to be toxic. She was a child of 13 when operated upon; hence a less radical operation was done. She had but a single metabolic rate reading of $+6$ at the time of the original publication; then $+8$ appeared for 6 years. She now is mildly toxic ($+28$) and has palpable thyroid masses.

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Three hundred and fifty-four of these patients have since been studied. 655 additional metabolic rate readings being made to date. Of these the patient who was toxic at the time of publication was subsequently reoperated upon. One had a single metabolic rate at the time of publication of $+3$. Subsequently she had two raised readings and was clinically toxic though her metabolic rate is now $+0$. One had an associated hemolytic jaundice at the time of operation. Her metabolic rate had not reached normal on the eighth postoperative day when she passed from under observation. She returned 4 months later in an acute exacerbation of her jaundice during which she died. The metabolic rate readings taken during this exacerbation were $+0$ and $+3$. Fourteen of the 43 patients on whom we had no data at the time of publication returned for further study. Of these one who had regarded himself as well for 7 years was obviously toxic.

Thus of 600 patients subjected to ultracal thyroidectomies the data on which have been published 559 have had some postoperative study. Of these 430 have been subjected to further studies including 600 additional metabolic rate readings. But of these 430 not normal at the time of publication have since become 1 each after a single normal basal metabolic rate. One of these is the 13-year-old child mentioned whose operation was planned to be relatively conservative because of her youth. In not a single patient in this series whose basal metabolic rate was normal in 10 or more tests has there been a relapse of thyrotoxicosis with a rise of metabolic rate.

A further study of 500 additional patients subjected to thyroidectomy shows but a single patient mentioned below who after three normal basal metabolic rate readings showed a definite rise with evidence of thyrotoxicosis. This single possible exception in

a series of 1100 cases was a patient whose metabolic rate tests were made at 11 intervals with practically no medical supervision during which he may very well have had periods of thyrotoxicosis. It is conceded that thyrotoxic patients not subjected to operation may have periods of quiescence certainly, thyroidectomy is so complete may not prevent this. The very great number of conservative thyroidectomies that are followed by permanent benefit show how wide a latitude is permitted the surgeon.

To determine the nature of what is commonly described as a relapse a study was made of a series of 50 patients presenting themselves for a secondary operation following failure of a previous thyroidectomy. Thirty-two had their first operation elsewhere, 18 by me. Most of these patients reported themselves as having been well for various periods of time following their original operation ranging from 8 months to 13 years. Forty-one of these patients had had no adequate medical supervision and no basal metabolic rate studies during their period of seeming well-being. Eight of these patients had been adequately followed clinically with repeated metabolic rate observations. All 8 of these we found to have been consistently toxic throughout. Some had occasional normal or low metabolic rates especially while taking iodine—none had consistently normal rates at any time. These were all obvious failures and not relapses.

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Mortality. The ultracal thyroidectomy is one thing planned not merely to lessen the incidence of immediate failure and the relapse of thyrotoxicosis but to lower mortality. The basic idea (3) is that not enough pathological injury is left to permit a serious postoperative thyroid crisis. According to this concept on it is precisely the most toxic patients the poorest risk patients who require the most radical operation and that at one sitting.

The case was one death in each of the two series a total of 2 deaths in 612 cases a patient mortality of 0.34 per cent.

In a study of results in older patients of that in a consecutive series of 1000 patients of whom 200 were over 50 years of age there were

ACUTE AND CHRONIC INFECTIONS OF THE PAROTID GLAND

TREATMENT BY DILATATION OF STENSON'S DUCT

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INFLAMMATION of the parotid gland has been known since the time of the ancients. "In the first book of the *Prorrhethika*, Hippocrates makes frequent reference to inflammatory swellings in the vicinity of the ears, which he describes as occurring in certain febrile and cachectic conditions. In indicating the topography of these, he says that they lie beside the ears. Before the days of Pliny these merely descriptive Hippocratic phrases had crystalized into a proper name—the name of a disease. In several passages, as for example, *xx*, 1, 15, 21, *xviii*, 7 to 11, *xxxv*, 17, Pliny gives the names of remedies which are used for the disease parotides. Galen, in a like manner, makes a number of references to this disease." This "author specifically states that the parotides are abscesses beside the ears, called by some *castores*. Celsus (*vi*, 16) gives a brief account of this disease, and Paulus *Ægineta* describes at length the method of treatment which he considers most satisfactory (*iii*, 23)."

An analysis of the voluminous literature on infections of the parotid has been briefly and clearly done by Jennings in the *American Journal of Surgery* for June, 1930, and more elaborately in an admirable paper by Rankin and Palmer in the December, 1930, issue of the *Annals of Surgery*. We have, therefore, deleted the historical phase from this report. Briefly, there are two theories of the etiology of this disease generally accepted, hæmatogenous infection (the pyæmic theory) and infection from the mouth through Stenson's duct (the ascending theory). No attempt has been made to separate the cases reported, those reported by one author all apparently proving one theory and those by another as conclusively proving the opposite. Jennings suggests that in many instances both factors are present. When we turn to the treatment, however, we realize that Galen's concept of inflammations of the parotid as being abscesses is still generally accepted. All sorts of treatment including hot and cold applications, gum chewing, acid mouth washes, mercuriochrome intravenously, heliotherapy, etc. are advocated in various articles, the writer very often ending his paper with a description of the incision which he uses in incising the gland. Rankin and

Palmer offer what appears to be the most successful treatment to date—the use of radium. This treatment is undoubtedly of great value but unfortunately it is not at the immediate command of the average practitioner and surgeon.

All authors agree that as soon as suppuration can be definitely recognized, the gland should be incised. A certain percentage of these cases, however, will recover without being opened. Rankin and Palmer advise waiting until the process is well advanced and state that frequently drainage from Stenson's duct may occur, thus relieving the condition. This point will be elaborated upon in the discussion.

CASE 1. On December 24, 1924, one of us (W. H. H.) saw a patient, a young married woman, age 27, complaining of a bilateral swelling in the parotid region, and of considerable pain. This condition had existed for about one year intermittently. There was no history of an infection immediately preceding the first appearance, her only recollection being that the face became tender and swollen. Heat was applied and after a few days the swelling subsided. This recurred many times during that year. Alpine light, gentle massage, ice caps, gum chewing and other known therapeutic measures were tried without bettering the heat therapy. X-ray pictures taken during this time were negative for calculi. When first seen, the physical examination was negative, except for tender, hard swellings of both parotids. The mouths of Stenson's duct were red and cedematous. Pressure over the gland and along the duct was not productive. A small filiform was passed through the duct well back to angle of the jaw, its withdrawal being followed by cloudy secretion. Larger filiforms were then passed until the duct was well dilated. Massage of the gland and duct produced about a dram of cloudy secretion containing small shreds of pus. The same procedure was carried out on the other side with a similar result. Two cubic centimeters of 1 per cent mercuriochrome solution was instilled into each gland. This procedure was repeated twice at weekly intervals. To date the patient has been free from symptoms.

This procedure was carried out in several cases during the next 3 years with relief of the symptoms. In a conversation with the late Dr. Joseph Sailer a question arose concerning infections of the parotid gland and one of us (W. H. H.) cited his experiences. Dr. Sailer seized upon the use of dilatation of the duct in infections of the parotid as a procedure which was rational and suggested that further work along this line be carried out. The co-authors were invited to assist in this problem in the fall of 1928. At this time the idea

Monday the twelfth on Tuesday an average of 4.66 days

This drop in basal metabolic rate was undoubtedly substantially influenced by the postoperative administration of iodine but is more rapid than that which occurs in the normal individual on the withdrawal of thyroid that has been administered in excessive doses

SUMMARY

The proposition which I wish to present is that Adequate thyroidectomy as I have described it reduces the basal metabolic rate to normal with disappearance of all evidence of intoxication within a few days

Relief from hyperthyroidism is permanent

Completing the operation in one sitting prevents severe postoperative reaction and reduces the mortality to a minimum

A failure to accomplish our purpose is never due to failure of the operation but of the operation

What is loosely spoken of as a relapse is practically always a residual hyperthyroidism due to inadequate removal of the thyroid

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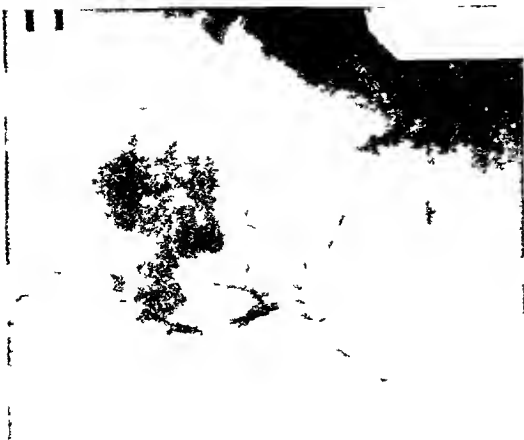


Fig 1 Normal parotid, right side, showing ramifications of the ducts and terminal branches

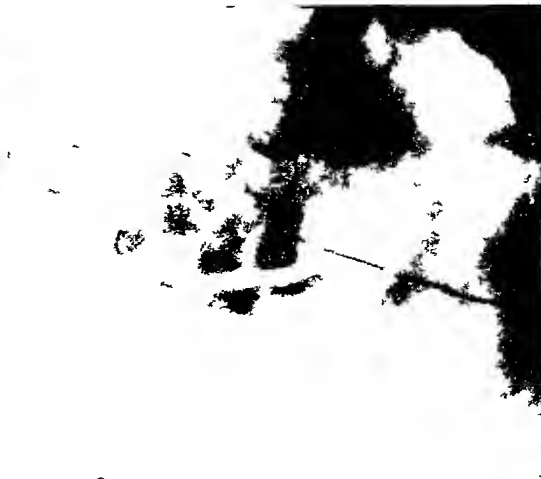


Fig 2 Normal Stenson's duct, right side, showing its relation to adjacent structures

of lipiodol. An immediate picture was taken with the needle containing the obturator in the canal, the patient holding this in place with his lips. Later plates were taken at 15 and 45 minutes with the needle removed. The only complaint during this procedure was of the taste of the lipiodol.

ADDITIONAL CASE REPORTS

CASE 2. M. B., female, aged 40 years. This patient was seen on February 2, 1929 on the tenth day following a cholecystectomy for acute cholecystitis with stones. The temperature which had been normal went to 103 degrees. Accompanying this, there was swelling and pain in the right parotid region. The duct orifice was pouting and

thick yellowish mucoid material could be expressed. The duct was dilated and irrigated with saline solution three times that day and twice the following day. Two cubic centimeters of 2 per cent mercurochrome were instilled each time. There was an immediate relief from the pain and the swelling subsided in about 48 hours. Twenty-four hours later the left parotid swelled with the reappearance of the same symptoms. This duct was also dilated and irrigated and the procedure repeated 24 hours later. Relief was immediate. The swelling disappeared in the next 2 days. Recovery was otherwise uneventful. The patient



Fig 3 Normal parotid, right side, showing accessory duct 1-distorted near its oral opening due to pressure of the needle which is still in place



Fig 4 Normal Stenson's duct seen from above. At the top of the plate is the gland end of the duct while at the bottom is the oral opening

of visualization of the gland by the use of a radio opaque substance injected into the duct was evolved without knowledge of the fact that this had been done previously. Sodium iodide was suggested but this was rejected because of its irritating properties. Lipiodol was used in the studies which we will present.

As a control for the experiments which we hoped to carry out it was deemed necessary that we obtain exact knowledge of the structure of the duct and gland from an anatomical and physiological standpoint. An attempt was made to dilate Stenson's duct in cadavers, inject the gland and take X-ray pictures thereof. We were unable satisfactorily to get into the ducts without dissection which was impossible on our material and which was not considered essential to our study. In the explanation of the following anatomical studies of normal glands in the living subject by the injection method we have accepted the structure of the gland as described in standard textbooks of anatomy.

The parotid gland consists of a main and accessory gland which lies below and in front of the external ear overlapping the upper part of the ramus of the mandible both within and without.

It is a compound racemose gland consisting of numerous lobes divided into lobules, each lobule of which is formed by the ramifications of a single duct, the branches terminating in dilated ends or alveoli on which the capillaries are distributed.

Stenson's duct is described as being 40 millimeters in length. It begins with numerous branches from the anterior part of the gland, crosses the masseter muscle and at the anterior border of this muscle turns nearly at right angles inward, passes through the corpus adiposum of the cheek and pierces the buccinator running between the mucous membrane and this muscle for a short distance and then opens upon the buccal surface of the cheek by a small orifice opposite the second molar tooth. It receives the duct of the accessory parotid while crossing the masseter muscle (Figs. 4 to 4).

The duct is dense, its walls being of considerable thickness. The canal is about the size of a crow's quill but is greatly reduced in size at its oral opening. At this point let us add this statement from Gray's *Anatomy*: "The walls of Stenson's duct consist of a thick external fibrous coat which contains contractile fibers and of an internal coat lined with short columnar epithelium. It is analogous to although not exactly the same as the uterus. Like the uterus it empties by peristaltic-like waves." Figure 5 shows this emptying clearly.

INSTRUMENTS FOR DILATATION

The instruments used by us to dilate Stenson's duct are very simple. Graded whalebone filiforms are inserted until the duct will allow the entrance of a 22 or 20 gauge needle. We have been using 4 inch needles with rounded points. Shorter ones will do however. The larger bore needle is better for lipiodol injections. In one case a No. 5 rat tail wax filiform was finally used and the patient at the present time passes it on himself. A 5 cubic centimeter hypodermic syringe was used both for irrigating and for injection of the lipiodol.

The cheek is grasped between the thumb and first finger of one hand, a piece of gauze being used to prevent slipping. The orifice of Stenson's duct is then located by the appearance of a drop of saliva after the buccal mucous membrane has been dried. If the orifice is not at once apparent we blow air gently on the area with an air syringe, this having the double effect of drying the mucous membrane and of forcing apart the lips of the meatus. We experienced difficulty in finding the orifice only in one or two normal cases in the aged. If the lack of teeth caused sagging of the cheek with a distortion of the normal landmarks. Once we have located the meatus we insert the smallest filiform passing it into the duct until it is stopped by the edge of the masseter muscle. At this point the cheek is stretched thus straightening out the duct and enabling the probe to slide along until stopped by the narrowing of the canal. The distance the filiform may be passed varies with the patient, i.e., the size of the duct and we must admit with the operator. At first we experienced difficulty in entering the meatus and later, passing the edge of the masseter. As we became more proficient we entered more easily a distance deeply in three different ducts we traversed a distance of 75 millimeters (about 3 inches). This is like ureteral catheterization in which the beginner having found the meatus at first finds its structure at this point and later at various points along its course. As already stated the duct is gradually dilated until it will admit the needle. This is then passed as far as possible although the needle as far as the filiform and the saline or mercury solution is instilled. The patient complains of a sense of fullness and some pain during the instillation. If do very slowly not more than 20 cubic centimeters if the solution becomes unbearable the pain will not be bearable. No anesthetic solution was used and we are deemed necessary. No patient objected to further treatment when necessary. In many of our patients we inserted the needle to the edge of the masseter and injected from 10 to 15 cubic centimeters.



Fig 7 First picture of Case 6. Note the pocket-like formations within the ducts of the gland and irregularity of Stenson's duct.



Fig 8 Second roentgenogram of Case 6 taken about one year later. The pocket-like formations are less pronounced.

cian for treatment. Examination of the gland externally was negative. The duct orifice was normal. Filiforms were easily passed along the canal and a lipiodol picture was taken (Fig 9). No further treatment was advised and the patient has not returned.

CASE 8 E. S., aged 10, was seen on April 20, 1929. Three weeks previously the patient had had a swelling of the left parotid. It was diagnosed as mumps and treated expectantly. The swelling gradually subsided in about a week. There was still, however, some fullness of the area and the patient complained of pain on eating. She was referred for treatment. Externally, there was a faint swelling over the gland which was slightly tender. The duct orifice was normal in appearance. Filiforms were passed easily and a lipiodol picture taken (Fig 10). No further treatment was advised and the patient has not returned.

CASE 9 E. T. T., aged 75 years, female, seen November 22, 1929. About 1 year ago this patient suffered from a painful swelling in the left parotid region following an attack of grippé. It subsided in a few days but had recurred frequently since. She stated that at no time was she severely ill with this condition. She had tried several types of treatment but could not say that they helped her. She stated that eating did not make it worse. The main symptom aside from the recognized pain was dryness of the mouth. She also complained of lack of appetite. Otherwise she felt normal. Physical examination was negative aside from slight swelling in both parotid regions, more marked on the left. Both glands were tender to palpation. The orifices of both ducts were red and pouting. Filiforms were passed into each canal without difficulty and pressure immediately following caused the appearance of a thick, mucilaginous flasky secretion. Both ducts were irrigated with saline and a lipiodol picture was taken of the left (Fig 11). On December 2, 1930, the patient stated that the pain was practically gone. The swelling was almost imperceptible at this time. The ducts were again dilated and irrigated. On February 7, 1930, the patient stated that she was entirely cured. No treatment was given. She reported by letter on April 6, 1930, that there had been no recurrence of the swelling and pain.

CASE 10 L. E., aged 30 years, female. Patient stated that about 6 weeks previously an ulcerated, right upper,

molar tooth had been removed. Two weeks later the right side of her face became swollen and tender. This was accompanied by severe pain on any motion of the jaw. Acute symptoms gradually subsided under local applications but the area was still tender and painful. Physical examination when seen (January 10, 1930) was negative except for a marked tender swelling over the right parotid region. No signs of acute inflammation were noted. The orifice of the right duct was somewhat injected and pouting. The left ductal opening was normal. Both ducts were dilated. The secretion from the left was clear and apparently normal. That of the right was thick and contained white flakes. Both glands were irrigated with saline solution. A lipiodol picture was taken of the right gland (Fig 12). On January 10, 1930, the patient stated that the pain was better. The swelling was markedly less. The right duct was again dilated and irrigated. On January 18, 1930, the right gland was normal in size and not tender. The patient stated that it felt perfectly normal. No treatment was given. She was last seen on July 7, 1930, at which time there had been no recurrence of the pain or swelling.

CASE 11 A. K., aged 69 years, female, was seen on June 3, 1930. On the eighth day of an attack of bronchopneumonia the patient developed bilateral swelling of the parotid. The crisis had occurred on the sixth day so that the temperature was 99½ degrees prior to this infection. The temperature rose to 103 at this time and was accompanied by extreme pain. Both meati were pouting and red and thick pus could be expressed from each duct by massage of the gland. The usual technique was carried out and about a half a dram of pus expressed from each duct. The patient experienced considerable relief almost immediately. The procedure was repeated daily for 5 days, although the swelling subsided in about 48 hours. There was no recurrence of the condition. The patient gradually failed however and died of vascular failure after all parotid symptoms were gone.

CASE 12 R. M., aged 63 years, male, was seen on May 21, 1930. This patient was seen 10 days following a suprapubic cystotomy for vesical calculus. He had not rallied from the operation and had become progressively weaker. At the time seen, he was semiconscious. The day previous he had developed swelling of the right parotid



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f t h m m m b M s a g f t h h k u s e d

f w d p f p p t l y r m l s a l t p p e Th
f h l d l y d m t h b t f t h d l e d

cr g d th f w t p p l t w d Th re
d y s l t th g l d w p d d l g m t f p

wa b t a e d Th w t l t d Th d h l e d
b o t w k

C 6 L R C g d 4 8 y r s p h y Dec h e
0 8 I 0 4 th p a t e n t h d l h t t k f g n p p e

T w w k f t r w d t h g h t p t d g d d f
b e c a m f l d t d w t h t m p a t u n g

a n d m g t h j w Th y m p t m b e d e d f e w
d y s d l o c a l p p l t S t h t h p t t b d

h d i n t r m t t t w l l g f t h p t d r y f w e e l a
A t t h t m th p w a s o t t h t h n a b l t

k T h u s d t y e d h m t h t t h t h
w w l l g t d r g y g l t t m t w h

d m e d e c e s s a r y f l f l d b d T m t b
t h f h w g g u m m g l p l g h t d u s

t h p o c d h d g l y t m p r y l e f W h
t h g h t p t d g a b t f g h t l l d

g n f t f l m m a t l d b t d Th h
f t b d t w p m t b t t f l m d O p r e s

m a l l m t f p p t l y m l l b t a e d
Th d t d l t d d p t m r e o c h m w a

t u l l d Th d f t h l g f i l m h w d m l l
m t f m p t d w h i t h m t l Th p t t

t e n d t 6 w k t l f d l t t d r g t l l
t t d t h t t h d y f l l w g h t m t h g l d

w t d d p f l b t t h t t m h
m h b t t h h h d b t y m p m l y Th

t d t l S p t m b 0 9 t w h t m N
t t l f i l m p d d t h p t t t g h t t

t h p h m s l l l w d g h t t
f 9 3 w h h t i d h w m h m p e d O

J r y 9 3 t h p t t t t d t h h d m d
q t m f t b t t h f t t m t t t m t h

g l d b e c m t d b t t h p t
b d d d y f l l g d l t t b y t h f i l m

E m u t t h u d t h d d f y l l
l n d t d r e s s Th m t p p e d m l

L p o d l p t w t k S e p t m b 8 9 9 d
S p t m b 9 3 (Fg 7 d 8)

C 7 W S g d y r s m l s e M r c h 9 9

O m t h p l y t h p t t t e d d l l g

t h n i g h t p t i g f l l g t t k f g p p e

Th w s o m p e p t g t h Th l l g

w t l r g d b e d f d y s t h t t

p p l t F t h p t w l h h a d m p l e d f

p a n t g d h a t h l f r e d b y h p h y



Fig 11 Shows marked dilatation and pocketing of Stenson's duct Gland not well visualized



Fig 12 Shot like appearance of gland Duct apparently normal

tender for about 24 hours but that the interval of relief was greater than when dilatation and irrigation with saline alone was done

Treatments were given not oftener than every 24 hours in the acute cases. Case 2 received treatments more often but the same result was obtained in our other cases treated less frequently and the patient was spared the discomfort of the procedure. In the chronic cases, treatment was given just prior to the recurrence of the symptoms (estimated) or when the symptoms recurred. Case 6 noticed that treatments at 6 week intervals kept him perfectly comfortable. The operator must use his own judgment in each case.

In reviewing the cases presented, we note several clinical facts.

First, all of the acute cases were ushered in by the classical syndrome of sudden acute swelling, associated with pain and rise of temperature.

Second, of the 16 cases presented, in 9 the orifice of Stenson's duct was pouting, red, and angry looking and thick mucopurulent material could be expressed on light massage of the gland and duct. Of these cases, 2 were comatose and the infection was merely an incident in a prelethal state (Cases 12 and 14). Treatment was therefore without effect. One case (Case 15) received but one irrigation, the treatment then being changed to the usual local applications. One (Case 16) received no treatment whatsoever. Thus, there were but 5 cases treated by the authors by dilatation and irrigation of the gland. These received daily treatments, and all subsided within 5 days. The case not treated by our technique throughout (Case 15) and the one (Case 16) re-

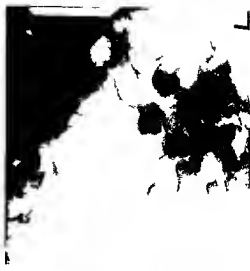
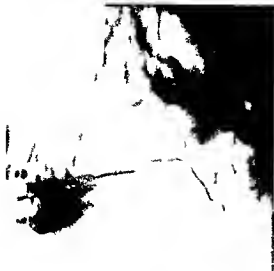
ceiving only local applications suppurred. One case (Case 2) received several dilatations the first day, but we deem that unnecessary.

Third, one case (Case 5) showed a normal duct orifice and secretion. This patient was aggravated by our treatment and required surgical intervention.

Fourth, of the remaining 6 cases, the 4 chronic cases all showed varying degrees of prominence of the orifice and some abnormality of the secretion. In these cases, our treatment carried out over a period of time, in 1 case (Case 6) over a year, resulted in a clinical cure. Thus in the chronic cases, showing a similar although less marked picture of prominence of the duct orifice and abnormality of the secretion, we may expect clinical cures when treated by our method.

In summary, all the cases reported in vital patients, whether acute or chronic, showing prominence of the orifice of Stenson's duct and abnormality of the secretion, were benefited by our treatment. The one acute case showing normal Stenson's duct orifice and secretion was made worse by our treatment.

At this point it seems wise to us to attempt to rationalize. Similarity between infections of the parotid and infections of the kidney have been mentioned in literature repeatedly. Since the advent of the cystoscope, the treatment of kidney infections has been fairly well standardized. Infections of the parotid are still treated in general according to Galen's idea of abscesses beside the ears. Infections of the kidney are roughly classed as infections of the parenchyma or kidney tissue proper, and infections of the



Fg Sh thk pp fgl dfl l ugm pa
D t rml

F o A pp tly rmalg d

gl d with ns ft mp t Wh ha t mp
t w 3 d gr Th p t d ga w m ledly
w ll Th m th w y f l Tb d t 6c w
p t g d ed d th k p rul t mat l l db
p es d Tb d t w d l t ed and r r g d with l n
Th t t m t ca ed h g th t m p t th
g l d t f th p t i H g r d l y f a l d d
d d h r s l t At th t m f h s d th w
h g th p p f th g l d d th d t
C a s 3 M T g d 4 y r s i m a l S p t m
h 8 93 Th p i t w th th d y f l w
g b d m l p t f t p p g o c y H
l s c h d h t f l p t th t m w h
h d d l y d e l p d w l l i n g f b o t h p t u d w i t h n s
f t m p r a t d e r p i n T b d t p e n a s w
e d d p t u g d t h k p r u l t m a t n l l d b
p d Sh e c d d l t t d l y f s d y s M c u
b m w l s o n t u l d b f i r s t t i m A l p t d
y m p t m d p p d b y t h t h d y Th p t w
d c h g d f m t h h p t a l 3 w k f t d m u
(Fg 3)

C s 4 A M g d 6 o y r s m a l w N m b
93 F l l w g p n l p t t e c t m y d p u l
x t h e s t h p t t b e c m a r m H w k e p t l i
b y e p t e d t r a d b e u t j t f
l b t w m a t t l t u m O t h t h d d y t h
g h p t d w l l d Th w t m p t h w
l m a t h w d t h l p p f t m
f l m m t Th d t w d l t d g t d w i t h
l A l g g t y f p r u l t m a t l v p d
Th i s h d f e c t p o h g l d t d h d e d 4
h r s l t

C s 5 (Th i s p a t t w t b y t h t h r s)
O t h t h d d y f l l w a n g p p e d e c t m y y g
w m a t h l f t p t d b m w l l Th w c e m
p n d b y r n f t m p t d n s d b l p Th
d t a d l t d d r r g t d w l l n b y
t r n w h d h d p l u m a n r y p p N f t h
d l t t w d t h p t t b g t t d b y w t

m p S p p t o c c u r r e d d t h g l d a s
e d 4 d y s l t C a l s c a t f l
C s 6 J G g e d y r s m l Th p t t w a
p t d f r u p t d p p d u w i t h p t n u s
O t b 93 C l t f t h p n t e a l f l u i d h e d t h
p i b c u l l t O t r a t t h h p t h
p r y t d h d t m p e t f d e g r F l l m
t h p e r a t h t m p e r a t f i t u t e d b t w e e a n d
4 d e g r H w a r r a t n a l d w r y d f i c u l t t
h d l d p t t h f m r p h a n H m t h w a s f o u t
d w k p t e l t h g r t d f i c u l t A t t i m e s h
t t f d f a c O n O t b 6 93 l l
g f b t h p t d w t d d w p p l e d m
m e d i a t l y Th p t t t m p t d g a l
d t m a i n e d b t h s a m O t h d f
l t t d i f t a t w m u t t d d t r t m t w a n e e d
t t h f h t w t p p l t n s D e s p t t h p a r o i d
f e c t t h p t t m p d s o m e w h t O n O t b
b t h g l d r u p t d t t h d t r y a l Th l l
g d y t h g l d e d b y m l l n j t b
l w t h A l g m t f t h k p w c u t e d
d d g n t t e d b y r u b b t h St p h y l o c c u
l b w l t d f m t h p C l e s c e n w
t f l d t h p t t a d u s c h r e d N m b 5
Th p t d w d t l y l e d b o t s l
A l p o d l p t w a t k p t b i s d i s c h a g (Fg 4)

GENERAL CONSIDERATIONS

In our f i r t a c u t e c a s e s w e a l w a y s s t i l l e d
m e r c u r c h r o m e a f t e r t h e i r g t i o n w i t h n r m a l
s a l i n e I n o u l a t e r c a s e w e o m i t t e d t h e m e r c
c h r o m e a n d w e f e e l t h a t o r r r s u l t s a r e a s g o o d
T h e m e r c u r c h r o m e s e e m e d t o c a s e s o m e r e
a c t i o n w h i c h w e f e e l i s u n n e c e s s a r y i n t h e a c u t e
c a s e s I n t h e c h r o n c c a s e s t h e u s e f m e r c u r
c h o m e h i p o d l o r s o m e o t h e r m i d l y i r r t a t n
s u b s t a n c e i s a d v i s a b l e D r C (C a s e 6) t o l d u s
t h a t f l w g e a c h i n s t l t i o n t h e g l a n d w a s

etiology. We personally agree with Jennings that either the ascending or the pyæmic type of infection may be present. From our work we feel positive, however, that those cases showing acute inflammation of the gland with a normal duct and normal secretion are pyæmic in origin. To our minds, it is like parenchymatous infection in the kidney. In the other acute cases, we felt that ascending infection plays the chief rôle, as here oral sepsis and lowered resistance are usually present. We are free to admit, however, that this does not hold true in all cases. Case 16, in which the cultures from the abscessed gland showed a different organism than that obtained from culture of the peritoneum would seem in favor of this view. But it is possible that secondary infection may have occurred.

CONCLUSION

In conclusion, we believe that our method of treatment of infections of the parotid gland, both in the acute and chronic cases, is a distinct advance upon the methods elaborated up to this time. It is physiological in that it drains the infection through a normal passageway. It differentiates between the type of infection which will respond to our method and that which will require surgical intervention. It requires no special instruments or unusual skill. It causes the patient little discomfort and gives a reasonable assurance of success.

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Fig. 3. Parotid gland. Stomach. Pelvis. Uterus. Vagina. Cervix. Endometrium. Myometrium. Perimetrium. External os. Internal os. Vaginal canal. Cervical canal. Endometrial canal. Myometrial canal. Perimetrial canal. External os. Internal os. Vaginal canal. Cervical canal. Endometrial canal. Myometrial canal. Perimetrial canal.

pelvis or drainage chamber. Parenchymatous infections either absorb or go on to abscess formation requiring surgical intervention. Infections of the pelvis have been treated by dilatation of the ureter and irrigation of the pelvis.

Surgical procedures are necessary only when the condition is too far advanced to respond to this type of treatment or when the parenchyma is involved as well. Infection of the parotid on the other hand no attention has been paid to the normal drainage canal. Stephens duct, Rankin and Palme called attention to this type of drainage but considered it a matter of good fortune when this occurs as it does spontaneously at times. Keith made use of this duct as a means of irrigation and his results correspond to ours. All other treatments consist of external application of some sort.

Turning back to pyelitis in the kidney, the question is not what the use of high alkaline lights possibly rays on the kidney, but on old relief the condition at times. The forcing of fluids and the use of urinary antiseptics. We know of course that very few cases of pyelitis are treated by drainage of the kidney pelvis. We feel certain however that were pyelitis treated by means of painless and deep massage patients could be treated by this method. According to urologists to whom we have talked fewer operations would have to be performed upon the kidney.

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Fig. 4. Parotid gland. Stomach. Pelvis. Uterus. Vagina. Cervix. Endometrium. Myometrium. Perimetrium. External os. Internal os. Vaginal canal. Cervical canal. Endometrial canal. Myometrial canal. Perimetrial canal.

In pyelitis in the kidney we demonstrate all proof of our pathology by injecting a radioopaque substance into the pelvis of the kidney. The pelvis may be distorted and the ureter at times shows narrowings in its caliber which if severe enough are known as strictures. Although the structure of the parotid and the kidney are similar they are analogous. If reason is correct should see abnormalities in the gland or pelvis as we call it and in the caliber of Stenoduct. The accompanying pyelogram on roentgenograms demonstrate this fact very well.

In the plates of normal glands (Figs 1 to 5) we notice that the duct is smooth the branches clear cut and the terminal duct is distinct. In the plates of infections of the pelvis of the parotid we note a blurring distortion or actual obliteration of these outlines. A close resemblance to the difference between normal and abnormal kidney pyelograms. The amount of distortion in both conditions depend upon the length and severity of the infection. In our chronic cases which we are fortunate enough to have pictured in medicine we see the same condition. It must be clearly understood however that these plates are not without fault. The parotid pelvis does not correspond exactly to a kidney pelvis and our plates therefore will not correspond exactly. In the pelvis infections of the kidney we often find distortions of the ureter. Our plates however mention the parotid duct. We have erroneously pointed out different anatomical forms and tend to. Our data is too small for us to attempt to differentiate pathological conditions as we have in kidney infections.

But the kidney does not embrace enough cases to make a positive statement at this time.

However, we often find the omentum attached to an abdominal scar in the lower abdomen without causing any noticeable symptoms. I would give preference to the operation that will prevent recurrence without deliberately fixing the omentum to the ileum.

3 Suturing the terminal ileum to the parietal peritoneum with two or three sutures to prevent recurrence. This may be an effective method of preventing recurrence, but it seems that the fixation of the ileum may interfere with normal peristalsis and give a considerable amount of trouble to the patient.

4 Suturing the terminal ileum to the cæcum and ascending colon for a distance of 5 or 6 inches has also been tried. This operation, too, will prevent recurrent invaginations of the bowel, but it may also interfere with normal peristalsis.

5 Some surgeons suture the cæcum and ascending colon to the parietal peritoneum to prevent the excessive mobility of the cæcum and ascending colon which is considered one of the chief factors in causing intussusception.

Another method in the surgical treatment of intussusception occurred to me while operating recently on an infant 5 months old. I believe it has some additional merits. Besides preventing

recurrence it does not alter the anatomy radically. Many of the operations that have been done for intussusception are prone to cause disagreeable symptoms necessitating a second operation in order to undo the mischief done by the first operation.

This operation which may be applicable to other areas of the intestines, is suggested particularly for intussusception at the ileocæcal region which is the site of occurrence in the majority of cases. Since there is present normally a slight degree of intussusception at the ileocæcal valve—an infolding of the ileum into the cæcum, the operation suggested is the suturing of the ileum to the cæcum with three or four silk sutures in such a way as to cause an outfolding of the ileum on the cæcum (see illustrations).

I am of the opinion that this simple procedure accomplishes all that the more elaborate and lengthy operations do and it can be done in 2 or 3 minutes. This time element is an important factor in lessening surgical shock which too often is the cause of unfortunate results. In addition to this operation, if the cæcum and ascending colon are abnormally mobile, they should be fixed to the parietal peritoneum by three or four sutures as suggested by Sir Berkeley Moynihan.

INTUSSUSCEPTION¹

SURGICAL TREATMENT IN REDUCIBLE CASES

O F LAMSON M D F A C S S W H I C

INTUSSUSCEPTION is said to be the chief cause of intestinal obstruction in children under the age of 5 from 50 to 75 per cent occur under 1 year of age.

It may be well to enumerate at least some of the etiological factors which have been advanced as causative agents of intussusception (1) excessive mobility of cæcum and ascending colon (2) narrowing of bowel at the site of intussusception about 80 per cent occur at ileocaecal valve According to John Fraser of Edinburgh a slight intussusception at the ileocaecal valve is a normal occurrence (3) Irritability of the bowel as a result with the increase in peristalsis (4) Relaxed mesentery of the bowel particularly the ileum (5) Hypertrophied Peyer's patch or intestinal polyp

Generally acute intussusceptions are associated with considerable shock. In the early stage vomiting is usually present with frequent mucus and blood stained stool. In about 70 per cent of cases a sausage shaped tumor can be palpated. In the beginning the abdomen may be scaphoid. But later distention is likely to supervene. Because the circulation in intussusception is impaired by the contraction of the bowel involved eventually gangrene will result.

The prognosis in many other acute abdominal lesions depends on early diagnosis and surgical treatment. Only a few years ago the mortality in these cases was quoted as high as 37 per cent

even when the patient was operated upon within the first 24 hours. When surgery was deferred as long as 3 or 4 days the mortality was as high as 65 or 70 per cent. Early recognition and prompt surgery are therefore very essential in the reduction of the mortality rate. As most of these cases occur in early infancy a very operative procedure which prolongs the operation is all naturally raises the mortality.

When the intussusception can be reduced it must be accomplished as quickly as a dwindle injury to the bowel involved as possible. After the reduction is achieved the surgical procedure must aim to prevent a recurrence of the intussusception. Some cases have recurred a major as four or five times.

The following operations have been tested and performed to prevent recurrence.

1 Shortening of the mesentery of the ileum by a continuous Lembert suture so as to make a fold on it. In this operation injury to the circulation of the bowel is often unavoidable. Because of this factor and the longer time consumed in performing this operation it is not advisable especially when the infant is already very ill.

2 Turning the omentum to the ileum at the ileocaecal junction is also recommended. This operative procedure has its merits and may be quite effective in preventing recurrence. It is chiefly based on the fact that it makes a secure comfortable tugging of the transverse colon and stomach



Fig 1



Fig 2



Fig 3

Fig 1
Intussusception
at ileocecal junction

Fig 2
Shortening of mesentery of ileum

Fig 3
Turning of omentum to ileum

Fig 4
Turning of omentum to ileum

Fig 5
Turning of omentum to ileum

Fig 6
Turning of omentum to ileum

EPILEPSY

GEORGE W. SWIFT, M.D., F.A.C.S., SEATTLE, WASH.

FOR many years epilepsy has been considered a degenerative disease of the brain. The degenerative changes have been supposed to cause atrophy of the brain, resulting in cortical irritation which in turn causes the convulsive seizure. Pathologists studying the subject have confined themselves almost entirely to the brain; physiologists have been unable to explain the peculiar phenomenon of the convulsive seizure. Treatment has been directed largely toward alleviating the spells by diminishing the irritability of the cortex of the brain with drugs. Thus the patients have been allowed to go on and finally with little or no benefit and a gradual mental deterioration ending in either suicide or death in some institution, accidental death due to the seizure or death in status epilepticus has been the picture of epilepsy through the ages.

Today, as the result of clinical observation and research in the physiology and pathology of the brain, particularly as applied to the cerebrospinal fluid, water metabolism and the anomalous dural venous sinuses an entirely new and different picture appears. Just as it was formerly believed that the glial formation caused the gradual contraction of the cortex resulting in convulsive seizures so it was also believed that the sole function of the cerebrospinal fluid was to act as a buffer or cushion for the protection of the brain and to carry off the by-products of neuro-metabolism. The fallacy of this conception of the cerebrospinal fluid shown by the work of Gamble completely changes this idea. Moreover it demands a change in the theory regarding the atrophied brain. If the atrophied brain is the result of accumulation of cerebrospinal fluid acting as a hydraulic press—as has been shown conclusively by Fay and Winkelman—the ischemic atrophy is caused by pressure exerted by shrinkage of the glial tissue. In other words it seems that the water cap (Fay) which surrounds the outer surface of the cerebral hemisphere and which extends into the cisterns and ventricles as well produces the pressure atrophy by hydraulic action.

Under all circumstances the convulsive seizure requires both an intact motor pathway and also a gradual irritation over a large surface of the cortex, particularly over the motor areas. With

this gradually increasing irritation to the cortex it needs only a sensory stimulus to set off the massive reflex action which constitutes a convulsive seizure. Just as the simple reflex caused by tapping the knee with the finger is a normal response so is the massive reflex of a convulsive seizure a normal response. The only difference between the flexion and extension movements of the runner as he crosses the tape in a hundred meter race and the successive contractions and extensions in a convulsive seizure is that one is purposeful and the other is not (Fay).

WATER METABOLISM

The research of Gamble, Ross and Tisdall on water metabolism has led to the solution of many problems in the study of epilepsy and has placed clinical observations upon a scientific basis. Gamble has been able to show that water metabolism plays a most important part in diseases in which edema or dehydration occurs. Briefly he has demonstrated that of all the water in the body approximately four fifths is intracellular in character, bound in the cells by a fixed potassium base. The fifth is divided almost equally between the vascular and the interstitial at rest, both being bound by a fixed sodium base. The vascular water is utilized in the ordinary metabolic processes and is replenished from the interstitial reservoir (Fig. 1). When more water is demanded for metabolic purposes it is readily supplied from this same reservoir; the largest accumulation of interstitial water being situated in the ventricles and the arachnoid spaces of the cranial cavity. Evidently this reservoir is placed in the safest part of the body, the bony skull, for the same reason that the brain itself is placed there, i.e., both are absolutely vital to life. Furthermore, this water must be accessible instantaneously by the blood stream and its situation in the cranial cavity fulfills this requirement.

In addition to the work of the above men, Drabkin and Shilkret, 1927, and Ravdin, 1929, have further shown that it requires a smaller dose of insulin to produce a convulsion in a hydrated animal than in a dehydrated animal. The thymic anterior pituitary lobe may be considered as the motor at the root of the diabetes as a factor in its etiology. This is an explanation of the strange effect of thirst and water for the most part.

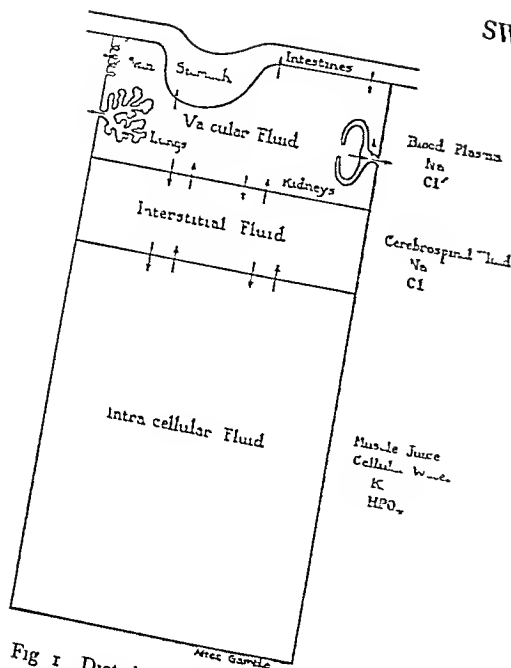


Fig 1 Distribution of fluid in the body

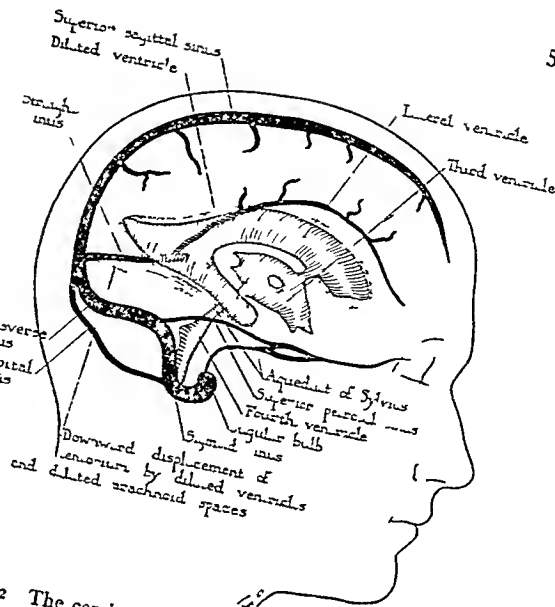


Fig 2 The cerebrospinal fluid forms in the ventricles as shown in the outline in the center, passes from the lateral ventricles to the third ventricle, through the aqueduct of Sylvius to the fourth ventricle and outward to accumulate in the basilar cisterns and over the cortex of the brain. The dark lines show the venous dural sinuses. The cerebrospinal fluid enters the sinuses above and courses backward then downward and laterally on either side, to leave the skull at the jugular foramen. The shaded area shows the displacement of the straight sinus, which responds to the plane of the tentorium, whenever there is a dilated ventricle or increase in the volume of brain substance, tumor mass, or accumulation of fluid in the subarachnoid spaces over the cortex.

cycle Berens (working in my laboratory) will soon publish clinical studies on this phase of epilepsy. These workers have given us a new conception of the importance of water metabolism and the functions of the ventricles of the brain. Gamble (1929) has shown exactly what occurs during the convulsive seizure. The rising tide of cerebrospinal fluid having gradually reached its climax, the basic sodium salt and water enter the venous channels and the circulatory system, and are eliminated largely through kidney excretions, perspiration, and respiration. Afterward, the cerebrospinal fluid pressure in the interstitial spaces returns to normal, and the cycle is repeated. Gamble, therefore, substantiates Fay's idea of a water cast causing a gradually increasing irritation over the cortex of the cerebral hemispheres. It is not possible to say at this time just what touches off the mechanism. S. Kinnear Wilson believes that it is neuronal in origin. Spiller and Fay share this belief. Lennox and Cobb (1928) add decreased oxygen tension as another factor in producing the convulsion. It may be true that any sensory stimulus could initiate the convulsive seizure. Furthermore, added pressure itself may be the chief factor.¹

To summarize, it is possible to say that water metabolism has an important rôle in the initiation of periodic convulsive seizures, that the accumulation of fluid in the subarachnoid spaces, cisterns, and ventricles of the brain brings about a constantly increasing irritation to the cortex of the cerebral hemispheres, particularly over the motor areas, and that this increasing pressure finally creates such a degree of irritation that the simplest sensory stimulation, even though psychic, may set off the actual convulsive seizure. Following the convulsion there is an elimination of fluid, largely through the kidneys but also through the skin and respiratory pathways. Modern research has established these factors as essentially the set-up for the convulsive seizure. Fay, in discussing the part water plays in the convulsive state, says:

"Viewed in the light of our experience with the acute and chronic convulsive state we have been forced to accept the fluid factor as a most important predisposing agent influencing other mechanisms responsible for the seizure itself."

¹Lund described thickening of the arachnoid and traction by the trabeculae producing a pulsating pull on the cortex as a possible source of subminimal stimuli amounting to irritation.

THE CIRCULATION OF THE CEREBROSPINAL FLUID

After leaving the cisterns and subarachnoid spaces the cerebrospinal fluid normally filters easily through the Pacchionian bodies into the superior longitudinal sinus and thence by way of the transverse and sigmoid sinuses, jugular bulbs and jugular veins it reaches the heart (Fig. 2). If however the Pacchionian bodies are faulty in development or are diseased (Fay and Winkelman) if the venous sinus is faulty in development if the jugular foramina are too small or if the pressure is sufficient from any cause to obstruct the easy flow in the jugular veins the cerebrospinal fluid becomes blocked first in the subarachnoid spaces and finally in the ventricles. Ordinarily large quantities of cerebrospinal fluid are stored in the reservoirs of the ventricles, cisterns and subarachnoid spaces ready for rapid withdrawal at any time but in conditions of faulty development or in those resulting from trauma or inflammation this mechanism is disturbed.

VENOUS DURAL SINUSES—

NORMAL AND ANOMALOUS DEVELOPMENT

Channel selection and rudimentary sinuses. Streeter has not only shown that the normal sinus development is symmetrical but that in some cases the right transverse sinus drains the superior longitudinal while the left transverse drains the straight sinus. This latter fact in itself is not important except that it shows that a variation from the normal symmetrical development is not uncommon. When the developmental process is complete even though the above variation occurs there is usually a confluence of the channels at the torcular Herophili and the blood may take either course as occasion demands.

Streeter uses the term *channel selection* in describing the peculiar selective process during the embryological development of the sinuses. By that he means the tendency for one vessel to become dominant among a newly formed group while the others by coalescence or even by actual obliteration are lost in the migratory process occurring in the growth of the brain dura and sinuses (Fig. 3). Undoubtedly this is the selective process so well described by Streeter that accounts for the many variations in the caliber position and even the number of sinus channels found in epileptics. That these anomalies are present in a very considerable number (Table IV) suggests their agency in the disturbed venous drainage in epileptic cases. The most common variations from the normal symmetrical system are the large right and the smaller or rudimentary

left transverse sinus (Fig. 4). Of less frequent occurrence are the dilated sigmoid sinuses which I believe are always associated with small jugular foramina (Fig. 5). In certain cases this dilatation is well established at the time of birth. In two autopsies where death occurred within 48 hours of birth there was a splitting apart of the dural walls of these sinuses (Fig. 6) the jugular foramina being too small to permit sufficient drainage. Both infants died in status epilepticus. X-ray pictures clearly show these sigmoid sinuses if the latter are largely dilated and as Pendergrass has demonstrated even the size of the jugular foramina can be determined. Other anomalies have been described in a former paper (Swift 1929).

In a series of operations upon epileptics I have found anomalous venous dural sinus development in 20 per cent of the cases. This would clearly establish a hereditary or a developmental factor as the cause of certain cases of essential epilepsy. This is in accord with the findings of S. A. Kinnear and Wilson that only 16 per cent of epileptics could be traced to a true hereditary background. I believe that these two groups of cases are identical in etiology due to a developmental defect rather than hereditary. This faulty development predisposes to mechanical obstruction due to the peculiar circulation of the cerebrospinal fluid.

Mechanical obstruction of the venous sinuses. Fluids circulate in a closed cavity do not increase in volume but only in velocity under variations in pressure conditions. In other words the amount of blood in the venous channels does not vary in volume under normal conditions. Thus an increase of intracranial pressure is compensated for by an increase in the velocity of flow within the venous channels (Monro-Kellie doctrine). Three elements are factors to be considered in a change from the normal: the brain tissue blood and the cerebrospinal fluid. If there is first an increase in one the brain substance the initial effect will be an increase in the velocity of flow of the blood while a further increase in brain content will displace the third element the cerebrospinal fluid. Since the cerebrospinal fluid is displaced by way of the venous channels it follows that any obstruction to the venous outflow will retard the displacement of the cerebrospinal fluid. This will in turn act as a further cause of increased pressure. Since the sinuses are largely above the tentorium this increased pressure causes a downward displacement of the tentorium (Fig. 2 dotted lines) thus compressing the walls of the transverse sinuses and decreasing the caliber of the sinuses (Fig. 7). As the caliber decreases a definite amount of cerebrospinal fluid increases a higher

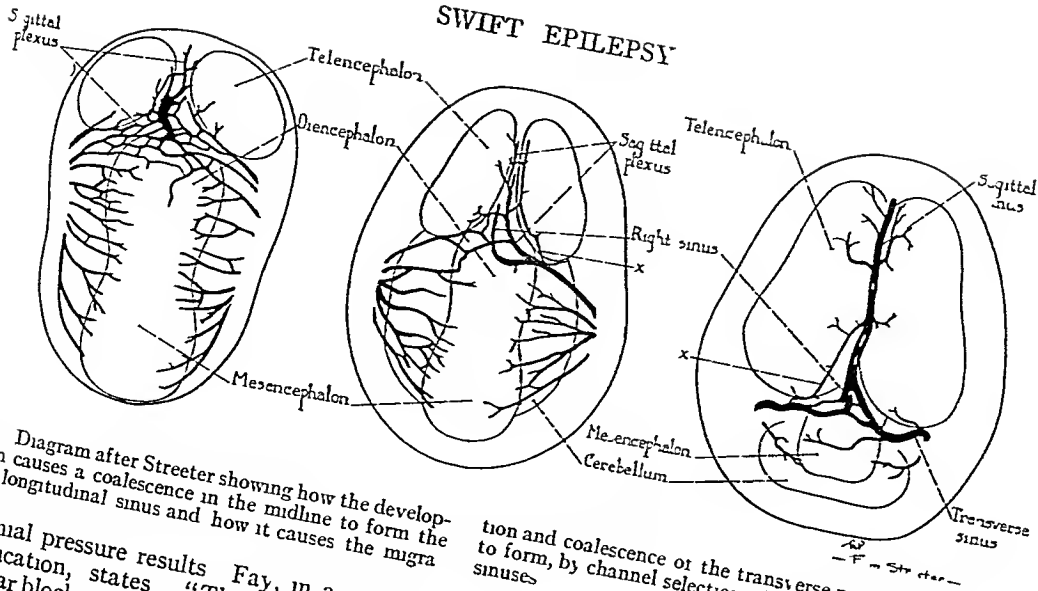


Fig 3 Diagram after Streeter showing how the development of brain causes a coalescence in the midline to form the superior longitudinal sinus and how it causes the migration

tion and coalescence of the transverse primary head veins to form, by channel selection, the right and left transverse sinuses

Fay, in a personal communication, states "Thus, if there is a ventricular block, the pressure should be sufficient not only to force the cerebellum down through the foramen magnum, but against a collapsible sinus Pressure must be equal on both sides of the tentorium and the only point of release is the venous sinus" This is illustrated in Figure 7 There must of necessity be some displacement downward and backward of the dural wall lateralward to the median line, while none occurs at the median line where the straight sinus is found Mechanically the set-up is perfect for a convulsive seizure Then as the head is thrown backward and the jugulars are placed in their optimum position for venous drainage, the venous blood is carried away, the cerebrospinal fluid pressure is dissipated Extensive study of defective venous drainage led to the development of the operation which will be described later I find that by mobilization of the transverse sinus it becomes impossible to compress the sinus when the tentorium is displaced downward

As stated, Fay and also Gamble have shown that a gradually increasing amount of cerebrospinal fluid is essential for the convulsive set-up A logical explanation for the retardation of the cerebrospinal fluid outflow by way of the venous channels is found in the faulty development of the venous sinuses This retardation may occur as a result of blocking at any of the following points the Pacchionian filter, the sigmoid sinus, the jugular transverse sinus, the longitudinal sinus, the jugular bulbs, the jugular foramina, or the jugular veins (Fig 8) Unless there is such a partial obstruction,

an increase in the cerebrospinal fluid may be easily adjusted by free drainage through these venous channels Because the factors which govern the transverse sinus are not found in any other sinus—namely, variations in caliber due to increased pressure—it follows, therefore, that the transverse sinuses become the important factors in what may be termed the threshold in epilepsy Increase in the caliber of these sinuses above normal tends to decrease the possibility of a convulsive seizure, on the other hand, decrease in the caliber tends to increase the possibility of a seizure The greater the obstruction of the venous outflow, the less the load required to produce a convulsion Senile epilepsy is an excellent illustration of a mild degree of decreased venous drainage, while that of young patients in which the jugular foramina are small but patent, with dilated sigmoid sinuses above, illustrates the severe type In the latter the brain is markedly atrophic, and nothing entirely controls the seizures Even constant spinal drainage gives only temporary relief, almost all die before reaching the age of 7 years Midway between the senile and the infantile types is that of women whose convulsions, having begun with the menstrual cycle, diminish or cease temporarily during pregnancy and stop at the menopause

A factor of importance should be mentioned here, namely, the effect of the position of the body upon venous drainage Lewis has demonstrated that the venous drainage reacts promptly to any changed position of the head or body He has been able to show, by means of an intricate mechanism for measuring the cerebrospinal fluid pressure, that variations in pressure cause changes in

TABLE I—PATIENTS OPERATED UPON FROM OCTOBER 3 192 TO NOVEMBER 23 19 —JJ CA ES

[illegible]

the venous return. These changes are caused by the position of the patient, flexion of the head, or the slightest pressure on the jugulars (Lewis).

Summary. Anomalous development and mechanical obstruction of the venous sinuses show that periodic convulsive seizures occur in the human, only when there is some interference with the outflow of the cerebrospinal fluid through the venous dural sinuses and thence to the heart. This obstruction may occur anywhere from the Pacchionian bodies to the heart itself. Under normal developmental conditions the dural venous sinuses can and do carry a variable amount of cerebrospinal fluid depending upon the metabolic processes of the body, the variations in water storage, as in the menstrual cycle, and the pathological changes associated with water metabolism incident to hydræmia in acute alcoholism, acute infections, and poisons. Anything that prevents this easy variability in circulation of cerebrospinal fluid, such as inflammatory conditions of the arachnoid, or diseased conditions of the Pacchionian bodies, may cause the set-up for a convulsive seizure when normally developed sinuses are present. In approximately 18 to 20 per cent of cases, however, anomalous or faulty development of the transverse dural sinuses, or the occipital bone and its jugular foramina, prevents this normal venous drainage. In these cases certain physiological conditions, such as an accumulation of cerebrospinal fluid, "may cause an anoxæmia of the frontal lobes which so lowers the threshold as to permit a sensory stimulus to explode the motor areas in the same way that loss of cortical inhibition and control of the lower motor neuron permits a more prompt and active response to a small stimulus in the tendon reflex" (Fay).

Thus it would appear that the hereditary influence in epilepsy, as pointed out by S. A. Kinnear Wilson, shows itself in this series of developmental defects of the transverse sinuses and occipital bone (Table V). Furthermore, while many of these cases may not have defects sufficient to cause more than a transient seizure during pregnancy or acute infection, or even to become manifest until arteriosclerotic changes of senility develop, they are, nevertheless, potential epileptics. That venous drainage is the essential factor, not only in epilepsy but also in the development of the sudden intracranial disturbances which occur in brain tumors, choked discs, acute dementias, et cetera, cannot now be questioned.

FIXATION OF THE TRANSVERSE SINUS

A knowledge of the attachments of the sinuses is important in understanding the mechanical

factors involved in the narrowing of the lumen of the transverse sinus (Fig. 9). At the point known as the torcular Herophili, a large emissary vein leaving the sinus system, attaches the sinus firmly to the skull. There may be several small emissary veins, and there is invariably a deep groove in the skull at this point. As the sinuses extend laterally to their junction with the sigmoid, the two dural layers, which split to form the transverse sinus, again become confluent and extend forward along the margin of the petron. The small, triangle-shaped superior petrosal sinus is situated between the two layers of the dura and joins the transverse sinus at its junction with the sigmoid, at a point which is always fixed (Fig. 9). This makes an angular formation of the tentorium at the superior posterior portion of the mastoid, and gives a fixed point on either end of the transverse sinus. Pressure from above downward, or displacement of the tentorium from above downward, collapses the lateral walls of the sinus and thus causes a narrowing at the angle where the sigmoid joins the transverse sinus. This is easily demonstrated on a cadaver. The slightest pressure from above downward will force the volume of fluid within the sinus upward into the superior longitudinal sinus with equal pressure. A variation in the sinus caliber will change the intravenous pressure to one equal or higher than the subarachnoid pressure. Weed, in experiments upon animals for the purpose of determining the effect of changed position of the body upon intracranial and intraspinal subarachnoid pressure, found the intravenous (dural) pressure curve to correspond with the subarachnoid curve—though always slightly below in actual measurement.

This fixation of the transverse sinus at the torcular Herophili and at the mastoid margin undoubtedly accounts for the increased pressure caused by tumors, either just above the tentorium in the occipital region or below in the cerebellar region. In the latter instance, however, the displacement is upward, also much less, due to the dense midline dural band which extends from the torcular downward to the margin of the foramen magnum. This band frequently carries a large venous sinus, the occipital sinus. Nature has provided, furthermore, a series of rib-like folds along the upper and lower surfaces of the transverse sinus, at right angles to the sinus wall, much like the knees of a ship on the under surface of a deck. In some cases these folds are highly developed, in others, there is practically no development. The falx cerebri coming down from above joins the tentorium and also assists in strengthening the vessel walls. In epileptics, however, the folds of

GROUP 2—SIXTY FIVE CASES—MORE EXTENSIVE OPERATIONS—EPILEPSY

WIFT EPILEPSY

TABLE II—GROUP 2—SIXTY FIVE CASES—MORE EXTENSIVE OPERATIONS—Continued														
Case	Age	Age at onset		Mental deterioration (-)	Encephalography				Results of improved operation			Deaths time operation		
		Petit mal	Grand mal		Date of examination	Pressure cerebrospinal fluid mm	Ventricular dilatation	Cortical air	Date of operation	Degrees of improvement (-) no improvement (-) in attack and mentality				
										Petit mal	Grand mal		Mentality	
35	11		Yrs											
36		6 mos												
37	12		3		5-3-8	4			7- -- 8					
38	24		6		7-11-8	40			7-16-28					
39	21		14		7-6-28	30			7-5-8					
40	9	6 1/2	16		8-16-8	30			8-15-28					
41	3	5 mos			9-6-8	40			8-0-8					Apr 9 1930 suicide (23)
42	6		1 1/2		3-1-28				9-10-8					
43	21		16		4-1-8	28			9-15-8					
44	12		4		8-1-8	3			9-18-8					
45	10		11		9-19-28	30			9-4-8					
46	5		6		9-20-8	30			9-5-8					
47	8	6 mos	1		11-13-28	0			9-6-8					
48	2		1		1-8-8	30			11-16-28					
49	2 1/2		1 1/2		2-1-8				1-31-8					July 1930 drowned (13 yrs)
50	5		22		1-2-29				1-8-29					
51	14		3 1/2		5-1-29	0			1-11-9					
52	5		1		-6-9	0			1-1-9					
53	5	9 mos			11-2-8	16			2-19-9					
54	1 1/2		19		5-11-9	30			5-11-29					
55	10		3		4-20-9	30			3-18-9					
56	28		14		8-5-28	34			5-7-9					
57	9 1/2		9		4-13-29	13			5-1-9					Aug 1929 cause unknown (8 mos)
58	18		14		6-18-29	0			6-1-9					Died on operative day status epilepticus and cerebrous meningitis
59	18		14		1-16-29	4			6-2-9					
60			3		-7-9	0			9-13-9					
61	13		18		8-3-29				-29-9					
62	8		6		-4-9				9-12-9					
63	3		5		-2-29	30			10-2-9					
64	0		1		4-4-29	30			10-14-9					
65	1 1/2 mos		1		11-6-9	0			11-18-9					
					5-1-29	2			1-11-9					
Average 9 mm									-1-9					
					Totals	6-	5-	10-	37					to death

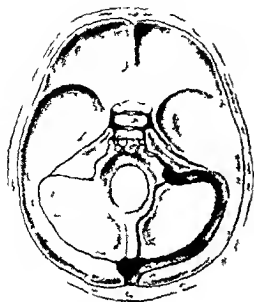


Fig 4 Asymmetrical development of the transverse sinus. Left transverse sinus is enlarged. Right transverse sinus is small.

the dura are conspicuously absent and the anomalous development of the sinuses prevents the symmetrical protective forces of the falx cerebri. Frequently the superior longitudinal sinus balloons out well to the right of the falx at its attachment with the tentorium and in such a case any pressure from above has a marked tendency to collapse the sinus (Figs 10 and 11). These conditions have been described elsewhere (Swift). In these abnormal conditions collapse of the sinuses must be prevented if we hope to obtain free cerebrospinal fluid circulation. This is made possible by the mobilization of the transverse sinuses.

Mobilization of the Transverse Sinus

Souttar reports that in operating upon the cerebellum for tumors he found that mobilization of the transverse sinus permits the operation upon the cerebellum. With this I have also found this to be true and Figure 12 shows exactly what occurs. In this instance a large cerebellar tumor had caused an intense intracranial pressure. When the plate of bone overlying the torcular area had been removed the distended sinuses could easily be seen. After puncture of the ventricle the sinuses flattened and at the second operation 3 days later they were still flat the pressure having been relieved. It is this mobilization of the transverse sinus over an extensive area in fact out to the margin of the mastoid that prevents a collapse of the sinus walls in the type of epilepsy just described.

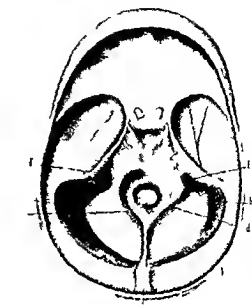


Fig 5 The position of the transverse sinus. The transverse sinus is shown in its normal position, with the jugular foramen and the internal jugular vein visible. The illustration is labeled with various letters and numbers, indicating specific anatomical features.

verse sinus over an extensive area in fact out to the margin of the mastoid that prevents a collapse of the sinus walls in the type of epilepsy just described.

Mobilization of the transverse sinuses then becomes of the utmost importance. Obviously this is of no benefit if there is an obstruction at the jugular foramen or lower in the venous drainage system. Only with secures such as the anomalous development or partial occlusion of the sinuses is it essential for the transverse sinus to be mobilized.

Indications for Operation

Application of the ethylen glycol procedure demands the observation of a certain regimen. Every case of epilepsy should have an encephalogram. The technique as described by Endergrass should be followed. If the X-ray pictures reveal bilateral enlargement of both transverse sinuses or a marked enlargement of the right without any particular enlargement of the sigmoid sinus, then the jugular bulb condition is one that can be markedly improved by mobilization of the transverse sinuses. Such cases always show atrophy of the frontal lobes of the brain.

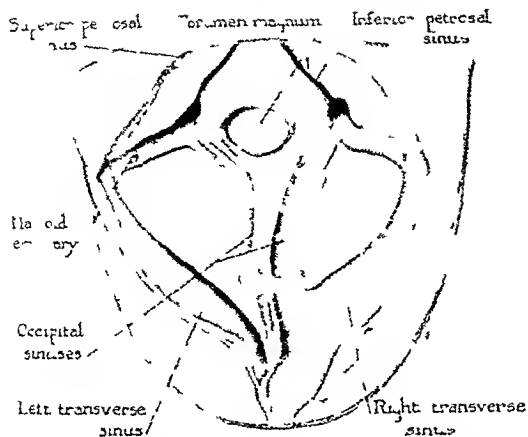


Fig 6 The tentorium has been almost completely removed, and the sinuses open longitudinally. The pressure in the right transverse sinus would appear to have split the layers of the dura so that an enormously distended sinus wall develops. To a less degree, this is also true of the right occipital sinus. On the left side dilatation shows above but not so markedly below.

CONTRA-INDICATIONS

Mobilization has not proved successful in cases of marked mental deterioration, nor has it proved beneficial to those patients in whom there is marked cerebral atrophy, particularly over the occipital as well as the frontal lobes. In my experience these cases are usually associated with very small jugular foramina.

Other contra-indications include traumatic epilepsy with localized accumulations of cerebrospinal fluid. An operation over the affected area is indicated rather than the mobilization of the sinus. Epilepsy due to inflammatory conditions in early childhood, such as meningitis, is not benefited in any way by the mobilization. In regard to idiopathic epilepsy I have found that about 1 case in 5 responds to this operative procedure.

OPERATION

For the alleviation of this condition, an operation has been devised. A cross-bow incision is made from mastoid to mastoid. The bleeding from the margins is controlled by Andrews clips. The lower flap is reflected downward to the attachment of the muscles at the superior nuchal line. These muscles are sectioned crosswise and immediately picked up in a Kellie forceps, and a suture is placed so as to draw the muscle margin firmly to the aponeurosis above. Next, the flap is reflected downward until the margin of the foramen magnum comes into view, and self-retaining retractors are placed. After the field has been

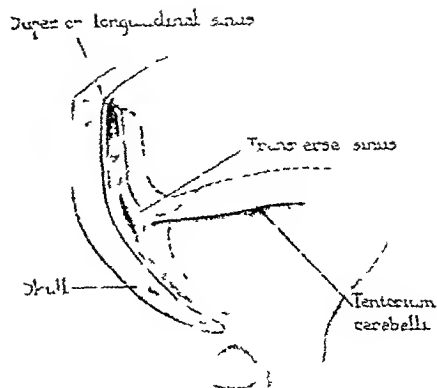


Fig 7 Schematic section to the right of the torcular showing compression of the transverse sinus with displacement downward of the tentorium cerebelli. Dotted lines show the normal position of the tentorium and the interior wall of the sinuses.

draped with small towels, four trephine openings are made (Fig 13), one on either side of the midline about equidistant from the superior longitudinal sinus and the transverse sinus, and two on either side of the midline below the transverse sinus. The two lower openings are then joined by rongeur and the bone is removed down to and including the margin of the foramen (Fig 14). With a DeVilbiss the two upper trephine openings, as well as the lower and upper on the same side, are joined. The bone is then gently released. Care must be used not to pull away roughly the venous attachment at the torcular Herophili. By the sliding of a small separator from below upward, as much of the emissary vein as possible is saved. Frequently, this can be ligated but it should tear free from the sinus, a pledget of muscle will control the hemorrhage promptly. If there is insufficient release of pressure within the first 3 or 4 minutes after the bone has been removed, the bone overlying the transverse sinus should be bitten away, well out into the mastoid area. A change in pulse pressure will be noted by the anesthetist. The pulse will become quite thready and irregular, then return quickly to approximately the normal rate. The bone is gently replaced (Fig 15) and the skin flap is replaced and closed by interrupted sutures, a single rubber band being inserted for drainage. A bandage is placed not too snugly over the area operated upon, but sufficiently tight to prevent oozing.

Patients are always restless and sometimes move their heads quickly when coming out of the anæsthetic, therefore a rubber band is inserted to take care of oozing. The dressings are removed

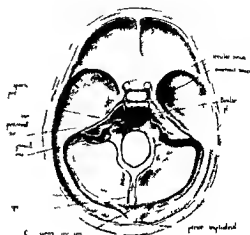
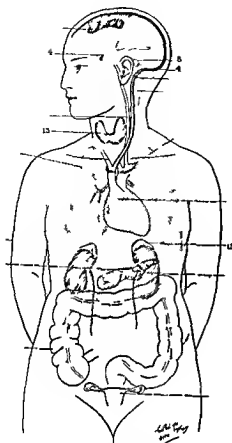


Fig 9 P t f f t f th t
h t th t cul h th m sary t th
y t m Emu t Iso t th t f b
p p t sal th th gm d h d

The da g points in the ope ation lie in hæmo hage at the torcular He ophi a d at the margin f the foramen magnum Sometimes a branch of the crteb al ve will cause tr ble some hæmorrhage B t as de fr m hæmorrhage there is no possib lity of a fatal ty a the res lt f the operati Co vuls e seizur s sho ld not occur immediately after per ton however if theyd the o nd should be opened search of a blood clot pre ng upon the med lla Co v l sions due to p ess re in this e a e associated ith sigh ng a d more r les cyan sis

As many f these patie ts ha e associated g stro- testu al d sturba ces marked c n tpa t n ore larged colon it s a good plan to gi e a tho ough catha is se eral d ys bef re a y per ative procedure If this s do e there ll be complicat s Occasio ally th adhe ns be t een the dura nd the bon o er the cer bell r f ssa a e so firm that the du a a darachno d a e t rn so that escape of cer br spinal fl id th ough orcmally of l ttl co seq ence may b e me qule e tensi e If th dressu g become rather m ist and shock ymptoms de el p t s ll to gi salt soluti n tnt avenously

SUMMARY OF CASES

Se ies incl des the frst 33 cases (Table I) ope ated po f m October 3 1925 to N ember

after the frst 24 hou s and th small ubb d ain inserted for g is ithdra The patient r mains in the ho pital for a eck foll wing th operation



Fig 10 A large right transverse sinus which deviates from the falx cerebri before it reaches the fixation point at the torcular, thereby lending itself easily to compression with displacement downward of the tentorium. A left rudimentary sinus. Marked backward bulging of the dura overlying the left occipital lobe

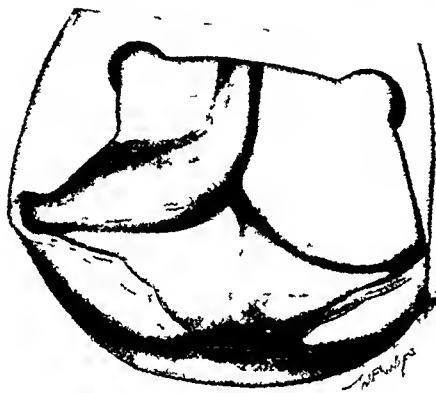


Fig 11 A dilated superior longitudinal sinus draining into an enormously dilated left transverse sinus. There is a rudimentary right transverse sinus and a very small occipital sinus normally placed

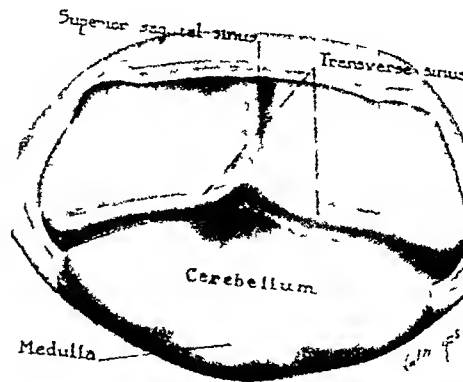
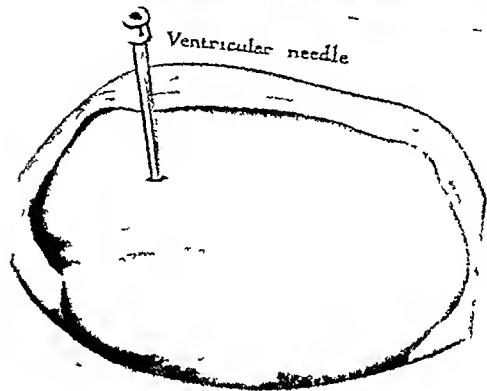


Fig 12 Normal sinus system in which marked intracranial pressure causes uniform dilatation of the superior sagittal and transverse sinuses as shown above. Below is seen the result of release of pressure above the tentorium. Acoustic nerve tumor P W



23, 1927, a 2 year period. The operation consisted of the removal of the bone overlying the medulla, extending from the posterior margin of the toramen magnum to the inferior curved line of the occipital bone, approximately 2 centimeters in width. There was one postoperative death due to hemorrhage, one patient died 9 months after operation, another 3 months after operation. The average age of these patients was 10 years, the average pressure of the spinal fluid was 28 millimeters of mercury. In the patients under 10 years of age (16 cases), all of whom were given an anesthetic, the average age was 3.8 years, the average pressure was 31.5 millimeters of mercury. In the degree of improvement in both grand and petit mal, there are very few (only 5 cases) showing marked (3+) improvement. 3 cases are cured

These patients were all true epilepsies referred mostly from the Children's Orthopedic Hospital Clinic or from family physicians for operation. Toward the latter part of the list more and more bone was removed. Improvement was not uniformly present, therefore, it seemed that in Case 33 still more bone might be removed with safety. The marked improvement of this patient and the presence of large transverse sinuses prompted the extension of the operative area to include a bedside to the bend at their junction with the sigmoid and superior petrosal sinuses. Series 2 includes 65 cases (Table II), with the more extensive operation in which the average age was 15 years, the average spinal fluid pressure was 29 millimeters of mercury. Those under 10 years of age given a general anesthetic—19 cases—had an average age of 6 years, pressure being 27.4 millimeters of mercury. The average of both

TABLE III—GROUP 3—TWELVE CASES

TABLE III—GROUP 5—TWELVE CASES

Case	Age	Age at onset		Mental deterioration (-)	Encephalography				Results of present operation			Sinus anomalies	
		Petit mal	Grand mal		Date of examination	Pressure cerebrospinal fluid	Ventricular dilatation	Cortical atrophy	Date of operation	Degrees of improvement (+) in attacks and mentality			
										Petit mal	Grand mal		Mentality
	Yrs	Yrs	Yrs			mm							
1	10½		10		1-13-30	30		+	1-22-30			Both large	
2	17		7		9-5-29	22		+	1-27-30		+	Both large occiput thick	
3	12	2½	2½	--	2-1-30	30	-	+	3-22-30	+	+	Left greater than right.	
4	9	4	4	--	2-1-30	40		+	2-2-30			Occipital bone thick.	
5	5	8	8	--	4-21-30	26		-	4-23-30			Left 3 times greater than right.	
6	17	12	12	--	5-1-30	22	+	+	5-3-30	+		Right and left large occiput thick	
7	22		21		5-3-30	28		+	5-7-30		+	Left 2 times greater than right.	
8	21		5	----	7-7-30	28		-	7-17-30		+	Left 2 times greater than right.	
9	20		13	----	5-23-30	30	-	-	8-1-30		+	Right 4 times left left rudimentary	
10	16		12		6-10-30	28	+		8-3-30		+	Right 4 times left left small	
11	20		16	--	8-27-30	30	-		9-1-30			Left 4 times greater than right	
12	5	Birth	24		2-4-30	25	+		9-9-30			Right and left small occipital large	
Average 18 yrs					Average 28 mm				Totals	4-	11+	10-	

TABLE IV—A STUDY OF THE VENOUS SINUSES IN 70 PATIENTS SHOWS 57 HAVING ANOMALIES

	Cases	Per cent
Dilatation of both right and left transverse sinuses	13	18.5
Dilatation of right only	17	24.3
Dilatation of left only	9	13
Contraction of right and left transverse sinuses	1	1.4
Contraction of right only	3	4.2
Contraction of left only	14	20
Total	57	81.4

TABLE V—A STUDY OF OCCIPITAL BONE CHANGES IN ONE HUNDRED AND TEN PATIENTS SHOWS EIGHTY-TWO HAVING VARIATIONS

	Cases	Per cent
Thickened	25	22.7
Thinned	27	24.5
Shortened	30	27.2
Total	82	74.4

the sinuses (Fig. 16) This has proved entirely feasible and satisfactory

Group III shows the final summary of 12 cases (Table III), carefully selected during the past year (1930). The average age is 18 years and the average pressure is 28 millimeters of mercury, 9 cases showed cortical atrophy, while 6 showed dilated ventricles—3 showed both, 2 cases showed marked mental deterioration

CONCLUSIONS

1. The periodic convulsive seizures associated with so called idiopathic epilepsy begin with a gradual accumulation of cerebrospinal fluid over the cortex and in the cisterns of the brain, causing a constant irritation to the cortex, particularly to the motor areas

2. The blocking of the cerebrospinal fluid may be due to inflammatory conditions of the arachnoid or Pacchionian bodies, or be produced by pressure upon any of the venous channels from the superior longitudinal sinus to the heart itself

3. A general state of hydration is essential for the convulsive seizure in all instances

4. Anomalous development of the venous dural sinuses is an important factor in epilepsy. Of these sinuses, the transverse sinus is of the most importance

5. In those cases of anomalous development it is possible, by mobilization of the transverse sinus, to restore a sufficient venous return to prevent, under normal conditions, an accumulation of cerebrospinal fluid in the subarachnoid spaces

6. The only complication that may arise during the course of this operation is postoperative hæmorrhage. This can be avoided by careful attention to all vessels at the time of operation

7 Indications for this operation are the presence of anomalous venous sinuses in true epileptics with otherwise normal physical condition.

8 Contra indications for this operation are the presence of disturbances due to inflammatory conditions resulting in obliteration of the openings into the superior longitudinal sinus (Pacchionian bodies). Local edema of the cervical spine is not a contraindication for this operation.

9 The results of this mobilization bring about a marked improvement in the mental condition of the patient as well as a decrease to a large proportion of the grand mal attacks and to a lesser degree the petit mal attacks.

10 The operation is applicable in only 20 per cent of cases.

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t h b p l f d t e c t t h b l
l p l p y B l J h l l p k l l p
9 3 x x 4 5
4 I d m I m p f t h p t h l g y l p l y f m
p t A m J P y h t 9 7 5 9 5
5 D W E d E m R S t d p n
m t a l p u l p y B l J h H p k H p 9 5
6 D x l 4 0 4 9
D L d S I l l h y d
m m p o t f t s e r v p h y l g
A m J P h y l 9 7 f x x 4 5 6
7 E C V d P F H I f l e l e l
t h d m t l t l p a p
t h e p t b l t m l t
A m J P h y l 9 6 l 5 9 3 5 9 7
8 F T m r C l i n i c a l b t t h t l f
l A m J P h y l 9 6 l 5 9 3 5 9 7
N l A m J T d 9 3 l 4 8 6 7
9 F T m r d W m N W d p d
p l p h y t t h b d t p h h l l a
t t t h f t f t h P h b o d d
t h b p l f d r e c u l t A m J P y h t
9 3 6 6 7 - 6 8 6
F O D I t h g d p l p t h
k m p f l l D e u t s c h Z i t s c h f n h
9 6 c i 5 5 3

- G m n J L E p l p y d e s f b o d y f l d
l m d t b A c h \ l & P y h t
9 3 9 5 9 9
G m n J L R G S d T a l l E F T h
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C h m 9 3 l 6 3 3 - 6 9
3 I I I B t g p t B h a d l g d
f C h A l l g m E p l p D e u t s c h Z i t s c h
4 L C l s H M t r u l l d s o d r s
d f t g l t h g m t c a d t l t
J A m M A 9 3 4 8 5
5 L W G d C S f p l p y M d
9 3 5 9 0
6 L H G R e p o t b e f t h A m c a C l l f
S g e o C h l k e s c a O c t b 3 9 1
7 P m o S F P A w g m t f t h B l y
d p h g m f t l g p l y A m J R t
g l 9 7 3 5 8 - 3 9
8 I d m I t r p t a t f e n p h a l g r a p h b s e
t m m t f t h l d u l t a t
A h N l & P y h t 9 3 9 4 6 - 9 8
9 P L J d l L S t d d
b t d t g t d f t f b t m A h
N l & P y h t 9 7 8 3
R l S D s s h f t h A f k e s c h
R N A m J T d N w y h d 7 9 9
9 5 4 5 3 7 7 5 0
S t t H S B t h M e d l A s s o c i t l e c t
b l t m B t M J 9 5 3 5 7
3 c A L g l t d t p d
d b t t d f t t t d t o
t z l l l a u A n n d l f t P t 9 6
4 S 3 3 W G S b t c a l p l p y B 9 4
S 7 8 7
G L T h d l p m t f t h
f t h d m a t t h h m a m b r y
A m J A t 9 5 4 5 8
6 S G W A m a l f t h g u l f m n a
P s e t d h f t f h h b t f A m M A s
P d t d O g J l y 9 9
7 I d m T h p o t f s a p l e p y l t d
h l A f R s e c h n r i A m J T d
N A k D m b 7 9 9
8 W m A T S m d t d z
g t l t h h d l g f l t l t h m b
L r y n g p 9 3 l 7 8 7 7 9 4
9 W L H t e c h a g e s t h b l n a l
A n d l l g t t A m J P h y l 9 9
j e c f s o l t f
3 W l s S V A S o m p t f t h p l m
f t h p l e p B t M J 9 9 7 4 5 7 4 9

MARCHING FRACTURES OF METATARSAL BONES

WITH A REPORT OF THE PATHOLOGY

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INSIDIOUS fractures of metatarsal bones may occur after exhaustion of the normal muscle and tendon support to the foot. Such fractures occur without obvious trauma, and without sufficient immediate pain to notify the patient of the injury. Weeks later the developing callus becomes painful and calls attention to the lesion, but by this time the swelling is apt to be considered a neoplasm unless the observer is familiar with the picture of a marching fracture. Search of the literature shows that the problem has engaged several European authors, but no American and only one English article refers to it. The following case is reported in some detail as it is quite characteristic of the lesion. The patient had been previously seen by very good surgeons and roentgenologists who had said she was suffering from a sarcoma, and she had been sent to the hospital to have an amputation of the leg.

The patient was a big healthy and rather obese woman of 30 years. She worked in the employees' cafeteria of a large company, and was on her feet all day long. She came to the hospital complaining of pain and a hard tumor in the left foot. Seven weeks previously she had noticed that she suffered pain just proximal to the second metatarsophalangeal joint when she bore weight upon the left foot. There was no trauma to the foot at this time as far as she could remember. The onset of the pain was very gradual so that she could not remember just when she first noticed it, but she remembered it troubling her as she stood behind her counter about 7 weeks before. She did not stop work, but as she continued the pain, which was slight at first, became gradually more severe. After about a week of this, the pain began to trouble her even when she was not on her feet and at night she began to experience a steady aching pain in the same region. This also gradually increased so that shortly it began to keep her awake a good part of the night. She had lost about 13 pounds since the trouble began and she attributed this to her loss of sleep as her appetite remained good and she had felt perfectly well all the time except for the pain in the foot. About 3 weeks after the onset she noticed that the dorsum of the foot seemed swollen and at this time discovered that she could feel a hard lump about an inch proximal to the second metatarsophalangeal joint. The lump had slowly increased in size up to the time of her hospital admission. Two weeks before this date she had reported to the medical department of the company employing her. She was referred to a very competent surgeon. X-rays were made. She was told she was suffering from a malignant tumor of the bone and amputation of the leg was advised.

Eighteen years ago the left leg was run over by an automobile and the left ankle was sprained. This healed promptly and has never given further trouble. She had scarlet fever 18 months ago. Apart from these, her past history was negligible. She was married and had two healthy children.

Examination at the time of her hospital admission was entirely negative with the exception of the left foot. She entered wearing a soft slipper on this foot, and although she walked readily when requested to do so, she walked with a decided limp. The dorsum of the foot was slightly edematous and pitted on pressure. At the junction of the distal and middle thirds of the second metatarsal bone a definite, very hard mass was felt. This was the size of a small walnut and gave very much the same sensation of a hard, irregular, globular surface as would a walnut felt under the skin. The skin was freely movable over it, but the mass was attached to and moved with the metatarsal bone. Pressure firmly made over the mass caused moderate pain. Voluntary and passive movements of the second toe caused pain. No abnormal mobility of the metatarsal and no crepitus were elicited. Routine blood and urine examinations were negative as was also the blood Wassermann test.

Roentgenograms (Fig. 1) showed a globular new growth of bone at the site of, and slightly smaller than, the palpable tumor. This entirely surrounded the shaft of the bone. The margins of the growth were hazy and indistinct. The medulla of the metatarsal showed no changes. The medial surface of the cortex under the new bone showed a definite, irregular, shallow erosion. No fracture lines were made out in any of the four films examined, although as fracture callus was suspected these were looked for carefully.

A luetic periostitis seemed unlikely in view of the negative history and Wassermann report. An unrecognized fracture with excessive callus formation seemed unlikely in view of the insidious onset, the absence of corroborating X-ray evidence, and the destructive erosion of part of the cortex of the shaft beneath the new bone growth. A neoplasm that had involved a portion of the cortex seemed the most likely possibility. The metatarsal was excised as a means of verifying the diagnosis.

Examination of the specimen (Fig. 2) showed a bulbous enlargement 1.6 centimeters long by 1.7 centimeters wide at the junction of the distal and middle thirds of the shaft. The soft tissues were firmly adherent to this. The surface was rough with small quite regular elevations about 1 millimeter in diameter. It was quite hard but could be dented with the fingernail. There was no point of false motion discovered on first examination of the metatarsal, and it was only after longitudinal section of the bone that the true character of the lesion became evident. There was a narrow, dark line of old hemorrhage and granulation tissue crossing the shaft almost transversely at the level of the bulbous enlargement. This stopped at the inner side of the callus on either side and did not involve the new growth outside the cortex. When stress was applied to the bone there was a very slight abnormal mobility visible at this line, but the new bone callus surrounding it supplied such efficient splinting that the movement was slight and had been unnoticed before sectioning the bone.

Microscopic sections through the new bone growth showed it to be well developed and partially calcified osteoid tissue. There was no evidence of inflammatory reaction. The microscopic differentiation between young callus after fracture and neoplastic disease can be extremely difficult, but here there was nothing to suggest that the latter rather than the former was responsible for the picture. The lesion



Fig. Ant. p. in. d. l. a. l. t. g. m. a. f. i. h. foot.

w d g d f t f i h h i t f i h b w h
m p l t p i r m a l l h e m h a g d b t l l
d t o l k f m m b l i z t f i h f g e n t a.

In 1855 B. eitha pt. described cases of perist. edematous and painful feet occurring in soldiers, without history of injury in soldiers.

who had been subjected to long marches and gave this lesion the name *F. ssgesch. dist.* He explained it as a traumatic inflammation of the tend. sheaths of the foot and stated that several weeks of rest and abstinence from walking relieved the condition. Weisbach in 1877 explained the same lesions in soldiers as being due to traumatic inflammation of the intermetatarsal ligaments rather than the tendons and gave it the name *f. Sydes. dist. Metatarsae*. Pau at a d. Poulet wrote about the same process but pointed out that it was primarily associated with marked periosteal proliferation (*P. s. i. l. Ost. pl. tigr. Ost. pe. osit. Rien. iat. ale*). Later and aided by the advent of the roentgenogram a large group of a third among whom were Schulte, Kirschner, Momburg and Baehr began to recognize that in the majority of cases despite the insidious onset and absence

of definite external trauma the lesion was a fracture of a metatarsal bone. The large groups of cases were entirely among soldiers who had been subjected to long marches and severe exhaustion. The lesions were recognized as being quite common. They reported 7 cases from one battalion in 3 months. The association between the lesions and severe exhaustion of the patient's foot became clear especially when the march was made with heavy pack and full equipment. It was intimated that the commanders rather than the feet were at fault. The rarity of the lesion in civilian practice was considered due to the civilian's opportunity to rest. He has tied Momburg explained the fractures as the result of an inflammatory change in the bone due to prolonged elastic bending of its structure. This could first result in persistent periosteal and if the stress continued in a fracture. Heradiograph of the feet of soldiers showed foot implants and showed that silent periosteal proliferations of the second and third metatarsal bones were common. Kirschner stated that the lesions were all due to friction or infection of the shaft of the bone. This was often treated

nized at first because there was little or no displacement of the fragments and they were well immobilized by ligaments. The fractures occurred when the defense of the long toe tendons and the intrinsic muscles of the foot, which ordinarily protect the metatarsal against much of the stress of walking, was eliminated by exhaustion. Jansen, in 1920, stated the theory that a spastic flat foot developed first in these cases. The spasm of the interossei resulted in a lymph and a venous stasis, and this in turn caused first periosteal proliferation and later an internal rearrangement of bony architecture which weakened the metatarsal so that a pathological fracture resulted. He also had roentgenogram series showing at first only periosteal proliferation with fracture appearing later. The incidence of these fractures—54.5 per cent in the second metatarsal, 36.8 per cent in the third, and 2.5 per cent in the fourth—seemed to corroborate this as these are the metatarsals having bilateral interosseous muscle attachments, but the more simple, mechanical explanation of Kirschner—that is, exhaustion of muscle and tendon protection—is an equally satisfactory justification of this incidence.

Deutschlander, in 1925, described a group of 6 cases very similar to the one I have described. Instead of being soldiers, as in the previous cases, his patients were all women in the third decade. They developed pain over the distal shaft of the second or third metatarsal that gradually increased. There was no history of trauma. By the eighth or ninth week an encircling periosteal new bone growth was demonstrable in the roentgenogram. This persisted for some time and then gradually became more fusiform and smaller and the symptoms disappeared. Because 3 of the patients showed a low febrile course, because the callus took 8 to 9 weeks to become evident instead of the usual 3 to 4 weeks of fracture callus and because of the absence of evidence suggesting trauma, he believed his cases could best be explained as a low grade, hematogenous bacterial periostitis. His stand is well taken and such a possibility cannot be controverted. However, he does not adequately explain the apparent immunity of the first and fifth metatarsal bones and none of Deutschlander's cases were examined after excision. In this, we have a case in which the sex, age, and clinical course simulate those of Deutschlander's so called "inflammatory tumor" and there was no history or roentgenographic evidence suggesting trauma. Yet examination of the metatarsal shows a concealed fracture, and histological examination of the callus shows no evidence of bacterial inflammation.

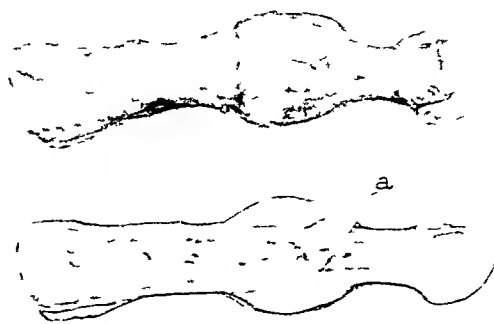


Fig 2 Drawing showing line of fracture at a

From a clinical standpoint, such cases should call forth the following reaction. When a case of apparent neoplasm involving the periosteum of the second, third, or fourth metatarsal bones presents itself, we should be most hesitant to rule out march foot. A luetic periostitis may be excluded by the history and serological findings. Central neoplasms of the metatarsal shaft will be verified or excluded by the roentgenogram. But the roentgenogram is not to be relied upon too strongly in differentiating this type of fracture from a periosteal neoplasm. The negative evidence of fracture is misleading as is also the erosion of cortex under the new bone growth. Especially, if the callus is at the site of predilection of this type of fracture—at the junction of the distal and middle thirds of the second or third, more rarely the fourth (11) metatarsal—we should hesitate to consider neoplasm. Unless the case for neoplasm were incontrovertible we should put such patients to bed with the foot immobilized. In a relatively short time after this has been done, the pain will diminish and the march foot tumor begin to grow smaller.

The treatment of the cases should be elevation of the foot with immobilization for 2 or 3 weeks. (2) Use of the foot actively may be started the fifth or sixth week. In the military cases, the average period of disability from duty was 49 days (12), but this should be somewhat shorter in civilian patients.

CONCLUSIONS

- 1 Fracture of metatarsal bones may occur insidiously as a result of long continued walking or standing.
- 2 Pain and callus formation later may simulate neoplasm.
- 3 It is suggested that some cases of Deutschlander's disease may belong in this group of fractures of metatarsal bones.

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OBSERVATIONS IN RAYNAUD'S DISEASE¹

WITH HISTOPATHOLOGIC STUDIES

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JAMES B. ROGERS, M.D.

IN 1866 Raynaud separated from the general grouping of gangrene from arterial occlusion a series of cases in which gangrene occurred without demonstrable organic disease or occlusion of the arteries. He described the obstructed flow in the arteries supplying the gangrenous part to an angospasm of the motor origin. The chief diagnostic criteria laid down by Raynaud were as follows: (1) attacks of local syncope and asphyxia involving the fingers hands to and feet more rarely the cheeks nose and lips of the ears the attacks usually being precipitated by temporary exposure to cold but occasionally from emotional excitement (2) the local characteristic features of pallor cyanosis numbness and lowering of surface temperature in the affected parts associated with light discomfort but occasionally severe pain (3) normal sensation a symmetrical distribution of the attacks the hands first a few minutes later the feet (4) the tendency of the disease to be progressive—the local syncope local anoxia and symmetrical gangrene being characterized by these stages of the same malady (5) the presence of arterial pulsations in the affected parts except during the attacks of local syncope when they may be feeble or absent (6) the preponderance of females over males.

Nothing very important had been added to the clinical knowledge of this affection until recently when appreciation of the clear changes occurring after certain operations on the sympathetic nervous system gave a rational treatment

based upon the long accepted assumption that the disease is primarily a somatomotor origin. Lenche found that peripheral sympathectomy gave relief of symptoms; some cases of Raynaud's disease. Other observers (5 and 6) found a malady and human experiments have cast doubt upon the efficacy of peripheral sympathectomy in the treatment of vascular disorders of the extremities. Adams and Brown (1) have studied cases of peripheral paralysis caused by lumbosacral resection a marked rise in the surface temperature of the desympathectomized limb a disappearance of the numbness of the fingers as applicable to the treatment of vascular disorders of the extremities operated upon by the Raynaud disease with strikingly beneficial results. Others (6) so published similar results as regards the lower extremities. Hence removal of the cervical sympathetic chain as suggested by complete resection of the first and second

After Knapp (9) showed that the effects of connection between the central thoracic sympathetic ganglion and the first thoracic paravertebral ganglion (10) predicted the successful treatment of a case of Raynaud's disease by resection of the first cervical and the first and second thoracic sympathetic ganglia. The latter suggestion was followed later by these same observers reported success in the treatment of patients treated since the American report. The results have been sufficiently encouraging to warrant further investigation by them. The striking

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maintained, and unequivocal therapeutic effects of lumbar and dorsal sympathetic ganglionectomy in Raynaud's disease seem to warrant the belief that surgical control of this disease is an accomplished fact."

The first cloud appeared on the horizon when Lewis took issue with the generally accepted belief that Raynaud's disease is due to vasomotor overactivity. His researches established reasonably well that a "local fault" in the vessel itself, rather than a nervous mechanism, was responsible for the symptoms of this disease. His conclusions were based upon indirect evidence, and no pathological studies were forthcoming to support his theories. A short time after his original report, Lewis (13) published observations on one postoperative case of Raynaud's disease. He found that he was able to induce typical attacks in the desympathectomized extremity (upper extremity) by exposure to cold. These observations confirmed his first conclusions and gave further weight to his theory of "local fault" predominating over vasomotor spasm as the causative agent of the disease.

This new point of view concerning the etiological factors in Raynaud's disease has cast considerable doubt on the theoretical soundness of sympathetic nerve surgery as a curative agent in this condition. The purpose of this paper is to review the details of our experiences with two severe cases and one moderately severe case of this disease treated by sympathetic ganglionectomy. Also the histopathological findings in the gangrenous fingers removed from one of the patients before and after sympathectomy are presented.

CASE REPORTS

CASE 1 H. G., sister of patient in Case 2, white female, housewife, aged 24 years, first came under our observation in August 1929. Six years ago she became extremely sensitive to cold weather, especially in the fingers and to a lesser degree in the toes. In December 1928 after exposure to cold she noticed that the ring finger of the left hand stayed numb and white. Soon discoloration appeared from the second joint to the tip of the finger, and in a few days it was completely black with a sharp line of demarcation at the level of the second phalangeal joint. She did not complain of pain. After the gangrenous finger had shriveled and become very hard and dry it was amputated just proximal to the line of demarcation. Healing progressed satisfactorily. She continued to have attacks of pallor and numbness of the fingers and occasionally of the toes brought on usually by exposure to cold but occasionally by emotional excitement. In August 1929 the index finger of the right hand became gangrenous without warning (Fig. 1). She has had occasional attacks of local syncope in the right side of head, cheeks, and eyelids. The family history was negative for similar vasomotor disturbances except for her only sister who likewise suffers from Raynaud's disease and her record is reported here as Case 2. The past history was irrelevant.

The general physical examination was negative except for the extremities. Blood pressure was 110-70. Laboratory examinations of urine and blood gave normal findings. Blood Wassermann was negative. Electrocardiograms and X-ray examinations of the heart and lungs were normal.

Extremities. Ring finger of left hand was missing. Index finger of right hand was gangrenous with a line of demarcation at middle of the first phalanx. The radial pulse was easily palpable. Surface temperature studies gave readings between 24 and 26 degrees C (see Chart). Capillary circulation in finger nails was sluggish. Acetylcholine hydrobromide 100 milligrams given intramuscularly caused a rise of surface temperature to 36+ degrees C. Capillary circulation in the nail beds became active after the administration of this drug (see Chart).

First operation was done August 21, 1929. A bilateral cervicodorsal sympathetic ganglionectomy was performed. On the left side, the inferior cervical first and second thoracic sympathetic ganglia with the intervening trunks were removed. On the right side, the stellate ganglion was broken during the process of removal, and the upper portion was not excised. Immediately following the operation, the upper extremities, neck, and face were warm and dry. Surface temperature readings of the hands ranged from 35 to 37 degrees C. A bilateral Horner's syndrome was present. The gangrenous finger improved steadily while the patient was in the hospital, the line of demarcation receding slowly until only the finger tip was involved (Fig. 2). She continued to have attacks of coldness of the feet and toes, and on one occasion the right little toe became cold, cyanosed, and numb.

She returned to the hospital on September 23, 1929, for lumbar sympathectomy. Her condition on the second admission was essentially the same except the Horner's syndrome was less complete. No sweating or reflex sweating was noted. The finger, which had been gangrenous, was now healed and of good color. Only the acra was lost, and a small portion of the nail had regenerated. No symptoms of Raynaud's disease referable to the hands had been noted.

On September 23, 1929, a bilateral lumbar sympathectomy was performed. The second, third, and fourth lumbar sympathetic ganglia with the intervening trunks were removed by the transabdominal route. The lower extremities immediately became warm and dry. Skin temperature of the toes was constant at 36 degrees C. The patient complained severely of a dull aching sensation deep in the legs and thighs, which was only temporarily relieved by elevation. This distressing complaint disappeared after 10 days.

Patient returned on January 10, 1930, because of gangrene of the right index finger. This digit, after assuming a normal state following the cervicodorsal sympathectomy, had given no symptoms for 3 months, and then gradually became gangrenous. The line of demarcation formed at the same level as before the operation. The finger was amputated at the metacarpophalangeal joint and the specimen decalcified for histological study. No further attacks of local syncope or asphyxia either in the hands or feet had been experienced.

On February 5, 1930, the first recurrent attack of pallor, numbness and loss of function occurred in the ring and little fingers of the right hand. Examination showed these two fingers to be pallid and hypoaesthetic in their entirety. Capillary circulation did not appear unduly sluggish. Surface temperature readings were 34 degrees C. Injection of the ulnar nerve with novocain showed a rise of surface temperature of 2 degrees C, and acetylcholine intramuscularly gave a like rise in temperature. The Horner's syndrome was incomplete, there being moderate dilatation of the pupils, more marked on the right side. Inasmuch as



F 1b tog ph f d cat f ghth d C h
 l g ly dry ga g f d ang b f p tu
 ph l n x f d m t mp f tly h tb fp x m l

lyp rt fth t l t g gh h db m d th
 ght d tth f t p t tw d d d t th
 t h b l w th p l g gl Th
 p t m p l t d th m l f th) m p t h gan
 g with th t r v g t r u k f m th p r al
 d m t th th d th g g l Th p t t t k
 l y p f th g d l t l f u w p m p tly
 f d f l l ang th p ed d th d g t r med t
 th r m l l d f t
 Th m th l t t m t f r s dd nly
 b cam d col ed d p f l f g g p
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f 3 Ph t g ph f b th h d C b f p
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F Ph t g ph f b th h d C sh ung th
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p r f m d t t h m t r p h l g l t d t h
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 t t f p h y x d b e c m b l a k d g a n g n o u s
 A m p t u p r f m d m b e s g l u n g
 th p t d d f d i g n t th gh t h a n d Th l t
 f u n g m p l t l y d m p e d t h t h u l t g a l
 e c t f d b t a s t t t y p p d
 C L S F m a l h u t h d d y a n
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 t p p t c a A t h s e t l t f t h s a m
 y h t h gh t h a h a d s a n d f t m s e n s
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 g e s d M l d t t k f p l l y d m b
 r r d th d g t l t h gh t h a n d f t b t h t h e r
 u r m u s o o b e m m l e d th t r a c k s t l e s s e r
 d g Th t t a k b m m f q t d d
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I J r y 9 9 th m u d d l f u n g f th gh t h d
 b c a m l d m b d p n f l D r y g a n l l y
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 (F 3) Th t t k t u n e d th th d i g n t l t u c u
 l a l y th g t t f th gh t f o o t l l u n g t h t a
 m th t h t l l y p p a c h d th p g a g
 t t Sh w h t b y t h t m
 P t h t r y s s t l l y g t Sh s e d i n
 b t t h y p o c h d l C l l
 l g q t t l l b t e s t th t t l t o
 t p k g d l y
 Th p h y l m t l d th g t m p t h e
 p t f t h m u t e s B l o o d p s s
 Th H b o t r y p o c e d e a l e d g t b l o o d
 W a s s m l i g h t d r y m u r m a l f e c t o
 d g p h t g d m a l u z h t d t
 m e d b y t g g p h u t d e s
 E s t m t Th m u d d l f u n g f th gh t h a d h a d
 l c a m p t t e d t h l t f th p p d m d d l l
 th d f t h p m l p h l Th f t p h l t h y
 d t h w d f d l y e d h u n g A t o m
 t m p e t f 6 d g r e s C th t m u t e s m o t



Fig 4 Section of digital artery from middle phalanx of the index finger of right hand, showing thickening of the intermediary layer of the intima $\times 70$



Fig 5 Section of digital artery from proximal phalanx of the little finger of right hand, showing thickening of intermediary layer of intima, thickening of the media, with hypertrophy and separation of smooth muscle cells $\times 70$

and felt cold with an actual reading of 29.2 degrees C. Surface temperature ranged as low as 24 degrees C. Acetylcholine, 100 milligrams intramuscularly, caused an elevation of surface temperature in all the extremities to 35+ degrees C on repeated occasions. The radial pulse and the dorsalis pedis pulse were palpable bilaterally. The capillary circulation of the finger and toe nails was sluggish.

The first operation was performed September 25, 1929. The second, third, and fourth lumbar sympathetic ganglia with the intervening sympathetic trunks were removed bilaterally. The convalescence was uneventful except for an attack of vomiting and epigastric distention shortly after the patient was discharged from the hospital. After operation the lower extremities were warm and dry. The skin temperature over a period of 2 weeks ranged between 34 and 36 degrees C. There have been no further attacks of syncope. Patient has been free of all symptoms in her lower extremities up to the present date.

On October 10, 1929, the second operation—a cervico-dorsal sympathectomy—was performed. The inferior cervical, first and second thoracic ganglia with the intervening sympathetic trunks were removed bilaterally. All symptoms subsided completely. The upper extremities were warm and dry. They were normal subjectively. A typical Horner's syndrome was present bilaterally. On February 8, 1930, the pupillary response to light was fairly good. The Horner's syndrome was incomplete. The patient perspired freely over the entire body but less than usual over the extremities. She has had no further recurrence of any symptoms 1 year and 4 months after the first operation.

CASE 3. M. M. female, white, aged 9 years, referred by Dr. Tom Marks of Lexington, Kentucky, was first seen by us on June 15, 1930, with the complaint of blanching and numbness in the fingers of both hands and occasionally similar attacks in both feet. In January, 1930, while coming from Sunday School she noticed a cold numb feeling in the tips of the fingers of both hands, and within a very short time this feeling had progressed upward to the elbows. The mother states that the hands were pallid at this time. From January 1930 to June 15, 1930, several attacks in the upper extremities had occurred. These attacks were characterized by blanching and then cyanosis, accompanied by numbness and a slight degree of pain. Only occasionally would more than the fingers be involved. Four was the largest number of attacks recorded in 1 day.

She noticed that her chin and left cheek became pale and numb on two occasions for a period of 10 to 15 minutes. The lower extremities had suffered six light attacks prior to June, 1930. The family and past histories were irrelevant.

Patient was a well developed, well nourished, and very alert child, who was mentally quite precocious. Physical findings were not remarkable, except for the extremities. A definite cyanosis was noticeable. Pulsation of radial and dorsalis pedis arteries was plainly perceptible bilaterally. Capillary circulation was very sluggish in finger and toe nails. Surface temperature ranged between 25 and 29 degrees C during the period of observation. Room temperature at this time was 24 to 26 degrees C. Acetylcholine hydrobromide, 50 milligrams intramuscularly, increased the surface temperature by 7 degrees C. Attacks could be induced by immersing the hands in water at 15 degrees C for 15 minutes. On a particularly warm day, it was impossible to induce an attack in this manner.

On June 23, 1930, the inferior cervical, the first and second dorsal ganglia with the intervening sympathetic trunks were removed. Convalescence was normal. Both upper extremities became warm and dry. A complete Horner's syndrome was present. Patient was free of all attacks until the onset of fall weather 4 months later, when attacks in the lower extremities became more pronounced and occurred every 2 to 3 days. At this time, the little and ring fingers of the right hand also suffered repeated attacks, but less severe than before. Temperature of the upper extremities was 34+ degrees C and only 29 degrees C for the lower extremities with a room temperature of 22 degrees C. Typical attacks could be induced by immersion of the extremities to the wrists and ankles in water at 15 degrees C for 15 minutes.

On October 29, 1930, the second operation—a periaxillary sympathectomy—was performed on the third part of the right axillary artery. The surface temperature was elevated 0.5 degrees C after the operation, the temperature being 34.5 degrees C with a room temperature of 22 degrees C.

Since the attacks in the lower extremities occurred more frequently and were more severe, third operation—a bilateral lumbar sympathectomy—was performed, November 18, 1930. The second, third, and fourth ganglia with the intervening trunks were removed on the right side. Only the fourth lumbar ganglion was removed on the left.



Fig 6 Sect n f dgt l t r y f m d tal pot f p m ipbl n fth l t h f gth d h th k n g fth t m d a r y l y fth m n th l g fth media th hype f phy d ep t fth m th m scl ll x

d C also s u u l \ f r t t l ha r r d th l m t s C m m f f b r r y s p s t e s t h t t h p a t i t h h d o e a t t a k f n p m l y t h d f i g f t h g h t h d T h t t l l d p o t t l d n y m p t m f b l t t h d h l t e d t h l w e t e m t e s d l t p p e t m t y

THE HISTOPATHOLOGY OF THE BLOOD VESSELS OF THE FINGERS IN RAYNAUD'S DISEASE BY JAMES B. ROGERS, M.D.

The histological evidence presented in the literature concerning Raynaud's disease is vague. Genet and Isaac Geo ges reported lesions in inflammatory in character involving the arteries in Raynaud's disease. In 2 cases lesions as present and in a third case a mild infarction as present. Simpson, Brown and Adams (12) considered the mild case a vasomotor neurosis and that abnormality of the digital arteries is a late complication.

The material presented here was taken from gangrenous fingers amputated from the same patient. The ring finger of the left hand was amputated in February, 1919, the index finger of the right hand in January, 1930, and the ring and little fingers of the right hand in August, 1930. Serial sections were cut at three levels in each finger.

OBSERVATIONS

Section through middle phalanx of the distal phalanx of the left hand. The portion of the finger distal to the amputation was found to be filled with inflammatory cells and the blood vessels were thrombosed. The blood vessels were found to be filled with inflammatory cells and the blood vessels were thrombosed.



Fig 7 Sect f d t r y from d l port m d p m a l p h l a n x f t h l l f i n g f g h t d t b l t t f t h l m l y t h l f t h t m l t h m b t m s s x o

Th (r r l t) m e m b a n c l d b n. The t m h o d f w l d s. Th t h i c k n e s s d t m e c t t u t r t t h c k e d n d t h e t m s c l l l h d l p p e a T h d t t m a l (f o a) T h d a l f i l l d t h e d r p s c l t h e s f h h d t t t l p o t f t h t m a u b t t t h m f r p s c l T h t f t h u n l t m a l T h l m f m a l t f i d t h l t g l l T h d t h l m l d t b e s e l u r h t h t m a t h k d d t h a r y m l d f f m t h m d T h m b t t h u c k d T h m e n f m l l G l l d t h l y t T h d t t t T h t f t h l l m a l p r e a I m l l f r y w h h m e d m t f n d t t t d t t h d t h l g l d l s e t T l t m f l d s d i t t e r l u t d f r t m m a d l e b t m n d d t C p l l e r t f u n c t S t t t t h t h p l p l a f t h l t h s t h e g h t a d T h d f g r e d t h d h d f e c u s T l s u r a f d g t a l t r y w d m t d l d t t w l l b y a m f e d r p s c l T h d t h l m t b t s o m e n d a t h l l l d b T t m d r y l t h l d T t m p e p a t h i t y T u t l s t e m m e m b r a l d t b e n t h m k d p t f t h l y s d m o o h m s c l T h p e p a b l g d b y m t h m l t h p e t y h d t e m t h m l s t a m m l l d t o e n. T h e h o u d b e f o u n d t h l h f t h d t y (F g 5) T h d e n t a l p r e d n t e o d m p t y T h d t h l m t t h t m t e m a y p e p e s d t h r p h m k d f m t h m d T h m e d t e d t t t h t h y t t h m o o h m s c l T h d t l l y m a n d f f m h m m T l l u m f t m a l l n d t h d p a l d t h l l s c d t p T l l m m d m t t f t h l l f r p s c l t T h t h l m s s

TABLE I—SUMMARY OF HISTOPATHOLOGICAL AND CLINICAL DATA IN CASE I

Fin er	D tes f ga gren	Ope p or dures	D of amp	Sec	N	Ar etal ch es	Venous han
K h d er l f	2-8	N	0-0	P minal	N	ase in co ne	N h es
				Middle balan	Yes	In ma d media in sed	N hanges
				Termin al h la	Yes	Th ca d ma th k ed me la	N h h one sh d gre
I d f f g h h d	8-20	C m d h m y	0-3	P minal	N	I eduary la er h k ed as	N h
				Middle phala	Yes	I m dary la er th k ed in as In th k d	N han
				Dental d	Les han in did	Th k d d media	N han
Lit l f g ugh hand	0	S p 2- mpa h m 0-	0-3	P minal	N	L m d l m l d d eda h k ed d bype	Ope pa ed
				Dental po m lph of	N	For some f in ma h k d l m as membran d laces	N h ng
				D l or mudd phal	N	L mass N d h l m l ter dary b h h ble f dia th k ed	Th b
R f er b hand	Sa sa l le	S m as b	0-	P l po in f rodow ph		E d h l m mos ly den d l m dary l er th k l l I th k d rub lse M dia fucles h per h ed	N h
				P halana l d l	N	L m d fl er f ed f th k d Media th ed	L rhtes

third case of only moderate severity. The discomfort was most severe as the attack was ushered in or departing. Normal arterial pulsations were observed in all 3 cases with the exception of the ulnar artery in Case 1 after all the digits had been lost from the right hand. All 3 patients were healthy individuals except for this local disease.

The operative findings were clear cut in each case. All of them gave excellent reasons for responses to the acetylcholine test; each patient experienced a rise of surface temperature in the involved parts to normal levels (a rise of 1 degree C was not uncommon). Also the capillary circulation improved with each diagnostic dose of the drug.

Symptoms have been completely relieved in the lower extremities in cases for 8 months and in the third case for 5 months following the operative procedures. In all of the patients symptoms have been completely relieved in the left hand. Two cases have had recurrence of symptoms in the right hand; one of the 2 has progressed to gangrene of all the digits of the extremity following a very extensive resection of the regional sympathetic system.

The conclusions that result from these cases of Raynaud's disease of the hands are not curable or controllable by the present day operative measures of the sympathetic nervous system. Three possible explanations for this failure should have consideration: (1) local changes in the vessel which may be the primary secondary cause of the disease; (2) incomplete removal of the central connection of the vasomotor system to the peripheral extremity; (3) the presence of a secondary vasomotor mechanism which is capable of functioning after all central communications are severed.

Local findings. Contrary to the symptoms arising from this disease are detailed changes in the walls of the arteries. It is thought to be borne out by the results obtained in these cases from sympathetic nerve surgery. (It does not attempt to say that the local factor may be derived from here at all.) Since a certain number of the patients are engaged in the pathological changes observed in the fingers, it is maintained from Case 1. Our direct evidence of local arterial changes as obtained from the study of amputated fingers which had undergone

peated periods of prolonged ischaemia. In three of the four specimens, a fairly generous area of tissue proximal to the line of demarcation was available for study. In all specimens, the digital arteries and their branches showed definite evidence of disease, consisting chiefly of thickening and fibrosis of the intima with hypertrophy of the media. These changes were more pronounced in the gangrenous than in the pregangrenous portions. In attempting to interpret the significance of these changes, one must first consider the possibility of these arterial changes being the result rather than the cause of the gangrenous process. It is, we believe, a generally accepted fact that arteries imbedded in inflamed tissue become involved, and all their layers undergo fibrous thickening, especially the intima. If the changes we observed in the vessels were confined to areas which had been gangrenous, we would be inclined to attribute them to a reaction secondary to the gangrenous process. But very definite evidence of arterial changes was found proximal to the line of demarcation in tissues which were essentially microscopically normal in appearance.

The first significant fact obtained from the histological study of the arteries was the predominance of changes in the large digital arteries with relatively few changes in the arterioles. If the underlying pathology in Raynaud's disease is a local change, one would expect the smaller branches to be involved to a greater degree than was evidenced.

Another possible explanation of the observed pathological changes would be that the vessels became diseased as the result of the long standing attacks of angiospasm. With each attack, the vessels suffered locally, and as the changes in the vessels became more pronounced, their ability to function between attacks became more and more impaired. Finally, the end point of adequate blood supply was reached, due to angiospasm and arterial occlusion, and the part became gangrenous. The fact that more pronounced arterial changes were observed in the fingers which were amputated last would support this view.

Incomplete removal of the central sympathetic connection. So far as we are aware, there is no case of Raynaud's disease of the lower extremities on record which has not been completely relieved of symptoms following sympathetic ganglionectomy. This fact immediately suggests the possibility that the difficulties encountered in treating the upper extremities are due to an incomplete removal of vasomotor activity to these members. Based upon our present anatomical knowledge of the vasomotor supply to the upper extremities,

every possibility of a central connection of these fibers in the upper extremities has been removed in Case 1, yet this patient has had no permanent clinical benefit from the sympathectomy on the right side. That there still may be vasomotor pathways to the arm of which we have no anatomical knowledge is not beyond the range of possibility.

It is known that many of the white rami do not end in the lateral ganglia of the sympathetic chain but proceed directly to various collateral ganglia. These ganglia act in many respects as a switchboard. One preganglionic fiber may synapse with many postganglionic cells. This permits of a diffuse and widespread action. The extensive communication of these postganglionic fibers may afford a long circuitous route through which vasoconstrictor impulses coming from a lower central level, namely, the third thoracic ganglion, may reach the blood vessels of the upper extremities.

There are more collateral ganglia in the region of the upper extremities, and a greater possibility for the dissemination of sympathetic impulses is thereby afforded, than in the case of the lower extremities.

Secondary vasomotor system. Another possible means of a continued sympathetic vasomotor action in the upper extremities is from a secondary system as described by W. Braeucker. He considers the sympathetic nervous system as an intercommunicating network of fibers. The blood vessels are supplied by a network of sympathetic fibers, which make central connections by a direct and indirect system. The direct system is a continuation of the sympathetic network on to the vessels while the indirect system is transmitted by way of the rami communicantes to the spinal nerves. This network is a special apparatus and is capable of living and of continuing function independent of central connection. Normally, the vasomotor impulses are conveyed via the rami communicantes and the sympathetic nerves, but when this is interrupted, the auxiliary system acts as a substitute and transmits the impulses directly. So Braeucker presents a dual mechanism for the transmission of impulses as well as a network of sympathetic fibers and cells capable of functioning independent of central connection.

If his idea of the vasomotor system of the upper extremities is correct, the operative procedures as now practiced will not permanently interrupt vasoconstrictor impulses. This possibility should have consideration, but until further evidence is forthcoming, it should have less consideration than the former two.

While our evidence is insufficient to establish proof of the underlying mechanism of Raynaud's disease we favor the assumption of overactivity of the vasomotor system as being the primary causative factor. Furthermore we attribute the failure of receiving permanent relief of symptoms in the right upper extremity as being due in the early cases to an incomplete removal of the vasomotor mechanism. The arterial changes observed may result from rather than being the causative factor of the angio spasm. Obviously in advanced cases where arterial changes have occurred removal of the entire sympathetic mechanism still would fail permanently to relieve the symptoms.

It would seem most likely that the remaining vasomotor control after the conventional cervico-dorsal sympathectomy must come from a lower segmental level. Accordingly it is our intention to include the third thoracic ganglion in the next operative procedure for this disease.

PHYSIOLOGICAL DISTURBANCES AFTER SYMPATHECTOMY

1. Horner's syndrome. This phenomenon in all our cases has been observed to be complete for only a short period after removal of the first and second dorsal and inferior cervical ganglia with the intervening trunks. Usually after 4 to 6 weeks pupillary response has returned to a moderate degree. The sweating mechanism to the face and neck has apparently been permanently destroyed in a case, but has partly returned in the third. Narrowing of the palpebral fissure has been insignificant in each instance when the ganglia mentioned were removed. In 1 patient (Case 1) in whom the middle inferior cervical first and second dorsal ganglia were removed unilaterally a complete and permanent Horner's syndrome on that side was produced.

Cardiac studies after sympathectomy. In all of our cases studies were made to determine the effect of cervico-dorsal sympathectomy upon the accelerator mechanism of the heart. The effect on graded exercise was studied both before and after operation on the pulse rate, blood pressure and subjective symptoms being recorded.

No significant changes in the blood pressure were observed after cervico-dorsal and lumbar sympathectomy. The response to graded exercise was normal after 4 weeks the heart beat accelerated to the pre-operative level with all grades of exercise. The return to the pre-exercise rate was accomplished in the normal manner as determined for each patient. No cardiac distress or other symptoms of discomfort relevant to the cardiac

mechanism were complained of even after fairly strenuous climbing of stairs.

Electrocardiographic studies showed no significant changes. Repeated X-ray studies of the heart over a period of 6 months following sympathectomy revealed no appreciable change in the size of the heart or aortic shadows. Thus later observation came as a surprise to us in view of the cardiac output determination (8) made on Case 1 and Case 2.

Ca	August 9 9-11	per	1
Cardiac output	7.38 l/min	rate	135/min
Mean arterial pressure	88 mm Hg	sec	1
Ventricular output	3.55 l/min	lit	1
Amplitude of blood in heart	33 liters		
Time	7		

C	Sept 4 9-11	er	7
Cardiac output	5.85 l/min	rate	135/min
Mean arterial pressure	98 mm Hg	sec	1
Ventricular output	3.35 l/min	lit	1
Amplitude of blood in heart	94 lit		
Time	66		

C	Oct 8 9-11	er	7
Cardiac output	5.85 l/min	rate	135/min
Mean arterial pressure	98 mm Hg	sec	1
Ventricular output	3.35 l/min	lit	1
Amplitude of blood in heart	94 lit		
Time	66		

C	Oct 8 9-11	er	7
Cardiac output	5.85 l/min	rate	135/min
Mean arterial pressure	98 mm Hg	sec	1
Ventricular output	3.35 l/min	lit	1
Amplitude of blood in heart	94 lit		
Time	66		

C	Sept 4 9-11	er	7
Cardiac output	6.69 l/min	rate	135/min
Mean arterial pressure	74 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	9 lit		
Time	9		

C	Oct 9 9-11	er	7
Cardiac output	5.56 l/min	rate	135/min
Mean arterial pressure	48 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	37 lit		
Time	4		

C	Oct 9 9-11	er	7
Cardiac output	5.56 l/min	rate	135/min
Mean arterial pressure	48 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	37 lit		
Time	4		

C	Oct 9 9-11	er	7
Cardiac output	5.56 l/min	rate	135/min
Mean arterial pressure	48 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	37 lit		
Time	4		

C	Oct 9 9-11	er	7
Cardiac output	5.56 l/min	rate	135/min
Mean arterial pressure	48 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	37 lit		
Time	4		

C	Oct 9 9-11	er	7
Cardiac output	5.56 l/min	rate	135/min
Mean arterial pressure	48 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	37 lit		
Time	4		

C	Oct 9 9-11	er	7
Cardiac output	5.56 l/min	rate	135/min
Mean arterial pressure	48 mm Hg	sec	1
Ventricular output	3.4 lit		
Amplitude of blood in heart	37 lit		
Time	4		

Each output determination was made under as nearly identical conditions as possible. During the first experiment (Case 1) a state of moderate vasoconstrictor spasm was maintained but otherwise the patient was composed and unexcited. The pulse rate during each experiment was practically constant. Unfortunately it was impossible to make simultaneous cardiac output records and cardiac roentgenograms.

What significance to attach to the output determinations in these cases we are unable to say. The possibility suggests itself relative to the increased output reported under the action of adrenalin (14) that an increased cardiac load

is being carried in Raynaud's disease, which is relieved by sympathectomy. The mechanism of this diminution of output is inexplorable to us at the present time.

3 *Changes in libido, menstruation, etc.* One of these patients (Case 1) states that after lumbar sympathectomy, her previous frigid state became promptly altered to one of almost abnormal libido. This statement is corroborated by her husband. The other adult patient experienced no change in libido following her lumbar sympathectomy. She had experienced, however, normal sexual intercourse throughout her married life. We have observed in certain young male patients, treated for deforming arthritis by lumbar sympathectomy, a fairly constant semi-erection of the penis. Presumably, these effects upon the genital organs arise from hyperæmia of the parts resulting from the vasodilatation. This observation is in direct contrast to the observations on animals made by Bacq, in which he reports impotence following a more extensive removal of the regional sympathetic system.

The character and frequency of the menstrual cycle was unchanged in our patients.

In one instance (Case 1), the convalescence was complicated by severe burning, aching pains in the thighs, legs, and feet. The only relief found for this symptom was elevation of the legs above the level of the body and head. Drugs and cold applications gave little or no relief. This symptom gradually subsided and disappeared after 10 days. Presumably, it was due to distention of the vessels much like the symptoms produced by erythromelalgia.

SUMMARY

1 Observations upon 3 typical cases of Raynaud's disease treated by sympathetic ganglionectomy are reported.

2 Complete relief of symptoms in all cases was obtained in the lower extremities and left upper extremity for periods ranging from 6 months to 18 months.

3 The disease has not been permanently relieved in the right upper extremity of 2 cases, in 1 case, all the digits of the right hand have been lost by dry gangrene after removal of the entire sympathetic chain from the level of the superior cervical ganglion to the third thoracic ganglion, also after periarterial sympathectomy of the axillary artery.

4 Histopathological studies were made on the amputated digits. Sclerotic and hypertrophic changes were found in the intima and media of

the larger arteries both proximally and distally to the line of demarcation. No significant changes were found in the arterioles or veins.

5 These clinical and pathological findings and their significance as regards the causative mechanism of the disease are discussed.

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ANOMALY OF RIGHT RECURRENT LARYNGEAL NERVE

JOHN DEJ PEMBERTON MD FACS ROCHESTER MINN SO A

MEREDITH G BEAVER MD ROCHESTER MINN SO A
D 15 17TH M C

IN the performance recently of subtotal thyroidectomy on a woman with exophthalmic goiter an interesting anomaly of the right recurrent laryngeal nerve was encountered. Since we had not previously observed such anomaly and since it is of surgical significance it seemed worthy of reporting. Because of the unusual and unexpected situation of this nerve it may easily be injured during resection of the right lobe of the thyroid gland.

In this case after resecting both lobes of the thyroid gland we were intending to ligate the right inferior thyroid artery outside the gland and as close to the carotid sheath as possible as it is often our practice as an additional measure in the prevention of postoperative hemorrhage. A structure was encountered having the superficial appearance of the vessel and arising in about the right situation for the inferior thyroid artery. A ligature had actually been passed around the

structure but had not been tied before in the careful examination showed it to be not a vessel but a nerve. As a nerve had never been found in this situation we were much interested in carefully dissecting it out in an effort to determine its identity. It was readily traced upward and was found to arise from the cervical trunk of the vagus at a point about opposite the superior pole of the thyroid gland. It coursed downward for the medial border of the parent trunk for a distance of 3 to 5 centimeters and then emerged from the carotid sheath nearly at a right angle to pass directly to the groove between the trachea and the esophagus in the region of the inferior pole of the thyroid gland (Fig 1). From here its ascending course apparently corresponded with that of the normal inferior laryngeal nerve. Further dissection revealed absence of any nerve along the lateral wall of the trachea below the level of the inferior pole of the gland. Therefore the nerve first observed and so narrowly escaping injury was the only inferior laryngeal nerve on the right side. The left inferior laryngeal nerve appeared to be perfectly normal in its ordinary course.

Because of the rarity of such an anomalous origin of the right recurrent laryngeal nerve we were interested to learn if it was described in the standard textbooks of anatomy or had been observed by others and reported in the literature. In Gray's *Anatomy* the origin of the nerve is described as follows: "The recurrent nerve on the right side arises in front of the subclavian artery, winds from before backward around that vessel and ascends obliquely to the side of the trachea behind the common carotid artery, and either in front of or behind the inferior thyroid artery. Essentially the same description is found in Cunningham's *Dissection* and *Illustrations of Anatomy*. The only one which suggests the possibility of any variation in the origin of the nerve is *Leçons d'anatomie*. In cases in which the subclavian artery arises dorsally the right recurrent laryngeal passes directly downward and then upward from the vagus to the larynx.

An article by Hooper in 1887 described the anatomy and physiology of the recurrent laryngeal nerves in detail. He quoted a paper by Sted-

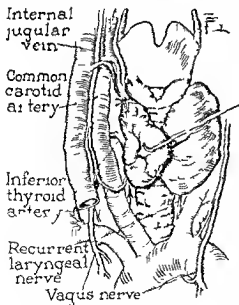


Fig 1. An illustration of the right recurrent laryngeal nerve. The right recurrent laryngeal nerve is shown arising from the vagus nerve and passing around the inferior thyroid artery. The diagram also shows the internal jugular vein, common carotid artery, and inferior thyroid artery. The vagus nerve is shown as a thick line, and the recurrent laryngeal nerve is shown as a thin line.

man, in 1823, in which was described the dissection of an aged female and the absence of the right recurrent laryngeal nerve. There were, however, nerves given off from the trunk of the vagus, about the middle of the neck, which passed directly to the larynx. There was also irregularity in the origin and course of the right subclavian artery. Hooper quoted Hart as reporting a case, in 1826, in which the subclavian artery arose directly from the aorta and the right recurrent laryngeal nerve came straight from the vagus and passed directly to the larynx instead of being recurrent. He quoted Hilton, Herard, Demarquay, Krause, Telgmann, and Brenner, as also having described similar variations in the right recurrent laryngeal nerve. In addition several of these authors described irregular origins of the subclavian artery.

Hooper stated that an irregular origin of the subclavian artery and of the right recurrent laryngeal nerve is common. He recorded the hypotheses advanced by early observers to account for this anomaly of the right recurrent nerve and discounted them all on the grounds that it can only be due to a developmental defect occurring during fetal life. He said "The proof that the course of the recurrent nerves is a question of development is found in the fact that when, from any cause operating in early fetal life, irregularities of the arch of the aorta or in the origin of its primary branches exist, the recurrent nerves have always in such instances an anomalous origin and course."

The only report found in the more recent literature was that by Milhamitch, in 1924, who described an anomalous arrangement of the great vessels arising from the arch of the aorta. He also described the right recurrent laryngeal nerve as arising from the vagus in the neck and passing almost horizontally to the thyroid gland. The left nerve was normal.

Other reports in recent literature, such as that of Fowler and Hanson, in 1929, Berlin and Lahey, in 1929, and Nordland, in 1930, have described the minute relationship of the recurrent laryngeal nerves to the inferior thyroid arteries, but the authors did not mention having observed an anomalous origin of the right recurrent nerve.

It would appear that an anomalous origin of the right recurrent laryngeal nerve is a relatively infrequent occurrence and has largely been lost sight of in recent literature, as is evidenced by the scarcity of such reports and by the fact that three of four standard textbooks on the subject of anatomy have failed to mention the possibility of such an anomaly.

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EDITORIALS

SURGERY GYNECOLOGY AND OBSTETRICS

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MARCH 1931

THE BIOLOGIC PREPARATION OF SURGICAL PATIENTS

PROBABLY the greatest progress in surgery during the last 25 years has been not from improved operative technique or newer methods of antiseptics or asepsis but from viewing the patient biologically.

In the beginning of this century for instance the mortality rate of operations for hyperthyroidism was high. The operation technically considered was more attractive than the procedures now used. The thyroid gland was exposed through a broad incision the vessels and nerves were demonstrated much as in the dissecting room ligatures and sutures were numerous and accurately placed and the whole operation was a model of technical skill—yet many of these hyperthyroid patients died. The operation as done today is far cruder from a technical standpoint. No effort is made to expose the nerves or any particular vessel. A portion of the thyroid gland is left posteriorly without trying to demonstrate the recurrent laryngeal nerve as was formerly the custom. The transverse

incision of the muscles of the neck has been generally abandoned and no more sutures are placed than are necessary to hold the wound together—yet after the modern operation most patients recover.

The difference in this decreased mortality rate is not due to improvement in the technique which has actually deteriorated from a mechanical and anatomical standpoint. It is due to the work of Plummer and others in finding that the toxic secretion from the hyperactive thyroid gland could be markedly altered by the administration of iodine. While the improvement may not be permanent a change that often lasts for many weeks occurs not only clinically but in the histology of the tumor. Operation with the patient under the influence of iodine is much safer than without iodine. It was found too that unnecessary trauma and exposure of tissue spaces are deleterious to the patient.

So in operations on the prostate gland. Removal of the prostate the day after the patient entered the hospital which was not infrequently done 25 years ago was followed by a high mortality rate. The operation was well executed but often the patient died. Gradually deflating the pressure caused by the obstructive prostate draining the bladder until the kidneys could work efficiently against the new pressure conditions decreasing the infection in the bladder by drainage made the patients much safer for operation. Here too the technique of the operation has not improved.

It seems that we are approaching somewhat the same status in surgery of the large bowel. In anatomical and histological struc-

ture as well as in function, the large bowel is quite different from the small bowel, particularly the upper small bowel. With the right half of the colon acting as an absorbent of salts and water, and the left largely as a reservoir, there is practically no digestive action. This storage property also makes the colon an incubator. It teems with bacteria. If a resection is done without a preliminary enterostomy or preparatory treatment by diet or intraperitoneal injections, breaking down of the sutures and peritonitis are prone to occur. The blood supply of the colon is less than in the small intestine. This, too, must be taken into account when resection is indicated. After the mesentery of the loop to be resected has been divided and ligated, the mesentery should then be cut along its junction with the bowel until a spurting vessel occurs. This insures a good blood supply to the sutured colon. If complete enterostomy after the old-fashioned method of bringing up the bowel on the abdominal wall and placing a glass rod under it, is done in the ascending colon 10 days or more before resection, the remaining portion of the colon receives absolute rest. The virulence and the number of bacteria are greatly diminished, the bowel contracts and bacteriologically the colonic contents are converted into the same condition as in the upper small intestine. Ten days or more after such a complete enterostomy, the resection can be done with an open technique as in the jejunum, and if the blood supply has been preserved, as mentioned, there need be no more fear of disaster than if the suturing were placed in the upper small intestine with its relatively sterile contents.

If the growth is large or the patient fat, the modified Mickulicz type of operation can be done, the mesentery being divided and ligated, the affected loop being brought up on the abdomen, the ends of the loop being

clamped and excised with the cautery. After either type of operation, however, the physiologic rest provided by the complete colostomy should be continued for about 10 days after the union of the ends of the colon. The enterostomy, which should be done through a muscle-splitting incision, can be readily closed.

The application of biologic principles in excision of the colon seems to be just as desirable as in surgery of the thyroid or of the bladder and prostate. No matter how carefully the resection is done, by a closed method or otherwise, a bowel that still has the burden of function upon it and is loaded with feces teeming with bacteria is not in the same favorable condition to resist infection or to heal as after a preliminary preparation which induces rest, removes the current of fecal matter, and diminishes the bacterial contents to a minimum.

J. SHELTON HORSLEY

FASHIONS IN PROSTATECTOMY

AS in many other conditions of varying pathology there is no constant unanimity of opinion in regard to the best methods of relieving benign prostatic obstruction. At an earlier period perineal prostatectomy held the stage. Then the work of Magill, Belfield, Fuller, and Freyer pushed suprapubic prostatectomy into the limelight where it has occupied a larger portion of the stage than any other method. But for a good many years various methods of attack upon the types of benign obstructing prostate glands through the urethra have engaged the attention of experts. Beginning with the prostatic incisor of Bottini, continuing with the punch operation of Young, later modified into the cautery punch by Caulk, these transurethral methods have held out attractive possibilities. Considerable

impetus has been given to them in the last few years by further modifications of instruments making possible better visualization of obstructive tissue and better control of hemorrhage.

Unfortunately the enthusiasm of experts and insufficient information on the part of the rank and file of the profession seem in some danger of pushing these transurethral methods of attack to the fore more rapidly than our knowledge and experience warrant. In the first place it is not always recognized that these procedures require rather unusual manual dexterity and they are almost certain to be occasionally undertaken by physicians whose training in urology both diagnostic and operative is insufficient. No operation on patients suffering from this disability will ever be free from risk. The precise risk in any individual case will depend partly on very complete knowledge of the condition of the patient not only as concerns his urinary tract but also as concerns his cardiovascular system and his resistance to the ravages of time and partly on the skill and experience of the surgeon. There is a growing tendency to regard these operations as trivial since they can often be carried out by experts with a minimum of hospital confinement and risk. That they are not trivial and can never become so must be evident in view of the fact that the accidents of infection and bleeding will require all of the resources of the trained surgical urologist and in view of the fact that these patients have a narrow margin of safety and may easily be pushed into eternity. There is grave danger that overenthusiasm in reporting immediate results of this procedure may place the more cautious surgeon in a very awkward position when he is called on to

advise a patient who has been lightheartedly told that his difficulty can be cured by a trivial transurethral operation.

One does not have to be as old as Methuselah to remember the vicissitudes through which all operative attacks on the prostate gland have gone and the extent to which highly promising procedures have failed to live up to prediction. For the present the profession will be well advised to maintain a conservative attitude in regard to transurethral prostatectomy. It is perhaps true that it may be or may become the method of election in dealing with the relatively small though highly obstructive lesions particularly those involving the glandular structures in the median line. That with improvements of technique the operation may prove satisfactory in a larger field is not improbable but it would be a bold man who would assert that the present evidence would warrant this conclusion. If the method is cautiously employed by well trained and dextrous surgeons it may achieve its position without the disappointments and catastrophes which have attended the enthusiastic receptions of most of the newer methods in this field.

For the present the older and better known methods whether suprapubic or perineal will in the hands of most surgeons prove better suited to the larger types of prostatic hyperplasia and will probably yield more lasting results. One may properly ask for this new candidate for favor in the field of operative technique a patient hearing free from ill advised criticism but also that it be not boldly pushed forward into a too prominent position from which retreat may be necessary and may prove embarrassing.

HUGH CABOT



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GEORGE M HORTON

"HE was a born Doctor—a favored son of the gods of medicine," may well be the epitaph of Dr George M Horton, whose noteworthy medical career terminated on May 6, 1927, in Seattle, Washington, where he lived all but the first 5 of his 62 years. Dr Horton was endowed by nature with great gifts, fitting him especially for his chosen profession to which he gave the best in him with a devotion seldom equalled.

Being a worthy servant of mercy, he made no distinction between the rich and the poor who daily thronged into his office. Undoubtedly he enjoyed one of the largest medical and surgical practices on the Pacific Coast. Hence, great is the multitude who mourn the passing of this skillful and much admired physician, who enjoyed the most valuable asset of a medical career—the affectionate regard of his patients.

Dr Horton was born in Shabbona Grove, DeKalb County, Illinois, on March 17, 1865. His parents moved to Seattle when it was only a village of a few hundred inhabitants. The ancestral farm on which he spent his happy childhood is now named Georgetown in memory of this great pioneer son.

After receiving a preliminary education in the public schools of Seattle and at the Territorial University, and driven by the inborn urge to serve suffering humanity, he went to New York and studied medicine at the Bellevue Hospital Medical School from which he graduated in 1890.

At that time it was not obligatory to spend additional years in a hospital for practical training under the guidance of experienced masters. Hence, the youthful doctor returned immediately after graduation to his home town and took up the practice of medicine.

However, he had the good fortune to be associated with Dr J S M Smart, a physician of wide clinical experience who had been his medical preceptor before he entered the medical college. Unfortunately, this association terminated after a short time by the death of Dr Smart and he was left alone to carry on as best as nature and a few years of study had equipped him. Through his innate fitness for the practice of medicine, good judgment, and indefatigability he soon won the confidence of the municipality and was made County Coroner for a term of 4 years.

He also devoted much time and thought to the fraternal organizations and in due time attained the thirty second degree in Scottish Rite the Knights Templar Degree in the York Rite and became a member of Nile Temple of the Mystic Shrine a member of Odd Fellows United Workmen Knights of Pythias and of Woodmen of the World

Later also in the medical associations he proved himself to be a just and an able leader as president of the King County Medical Society president of the Washington State Medical Association and president of the North Pacific Surgical Association

However as his fame spread throughout the Northwest and the number of his patients increased he felt forced to devote all his energies to the practice of medicine Being a decided individualist he preferred to work alone Therefore his time was almost too full to allow much diversion though once in a while he allowed himself the joy of witnessing a baseball game—the only sport in which he was keenly interested to the extent of sacrificing a few hours away from the office

It was not uncommon for Dr Horton to see 50 or 60 patients during an afternoon in spite of the fact that it was his custom to lock the door of his reception room promptly at four thirty in the afternoon

Possessing an unusual sense of responsibility to his profession and to those who sought his services he kept office hours also on Sundays in order to be available to anyone who could not consult him on week days Unstinted service to his fellow men was undoubtedly one of his outstanding characteristics Though for a number of years he was known as a general practitioner effectively covering all branches of medicine it was as a surgeon that he became distinguished He excelled particularly in abdominal surgery He was a member of the Western Surgical Association Pacific Coast Surgical Association North Pacific Surgical Association and a fellow of the American College of Surgeons

There are many of his colleagues who would wish with me that this great physician and surgeon had been spared to serve humanity as few are able or willing to serve

O F LAMSON

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REVIEWS OF NEW BOOKS

THE book on the *Diagnosis in Joint Disease*, by Allison and Ghormley,¹ is the first of its type to appear in English, and is, therefore, highly acceptable. It is in the form of an atlas which is supplemented by text. The authors offer the compilation of data from their experience in the study of 289 cases of arthritis over a period of 6 years. They present the clinical, radiological, bacteriological, chemical, and pathological data in these cases. They approach the subject from the standpoint of three main issues, viz (1) the etiological factor, (2) the tissue of the joint primarily affected, and (3) the character of the tissue change. The authors emphasize the fact that one of the important necessities in the study of joint diseases is greater accuracy in methods of diagnosis, and they urge too a common basis of classification of diseased processes.

The subjects covered are discussed in the following order: the physiology and chemistry of joint structures, the classification of arthritis, the classification of joint diseases, tuberculosis, traumatic arthritis, arthritis associated with loose body formation, pyogenic infections of joints, arthritis of uncertain origin, proliferative arthritis, and degenerative arthritis. Considerable space is given to the subject of osteochondritis dissecans.

The reviewer regrets to state that the authors omitted the following conditions: syphilitic arthritis, tumors of the synovial membrane, tumors of bone and synovial outpouchings or evagination.

They classify arthritis into 2 groups: those of known and those of unknown origin. Those of known origin are divided into 4 classes, namely (1) traumatic arthritis, (2) bacterial agent, (3) arthropathies, and (4) constitutional disturbances. Those of unknown origin are classified as (1) proliferative arthritis, (2) degenerative arthritis, and (3) unclassified. They believe that any classification should be based on the etiological factors responsible and on the primary tissue changes which result. They emphasize that disease processes are not of the bone but in the bone. In all forms of arthritis, with only one exception—namely, the degenerative form—the disease process primarily affects, first, the synovial membrane which proliferates, and, second, the marrow and connective tissue which proliferates.

All tissue changes such as atrophy and hypertrophy, loose body formation, eburnation, and cartilage destruction are secondary changes which

follow the process of synovial and marrow proliferation. The diagnosis of proliferative arthritis is positively made by tissue study and the finding of focal collections of lymphocytes in the marrow and synovial membrane.

Ghormley found that in 41 cases in which the diagnosis of tuberculosis of the joints was made, only 27, or 66 per cent, were proved to be tuberculous. In 52 cases in which the diagnosis of tuberculosis was set down as the probable cause of the joint disease, only 27, or 52 per cent, were proved to be tuberculous. In 42 cases in which tuberculosis was not considered as a possible cause, 23, or 55 per cent, were proved to be tuberculous. Twenty-nine per cent of all cases of arthritis remain uncertain of diagnosis after the completion of all clinical tests.

The book is of unusual size and is very attractively and handsomely produced. The illustrations include photographs, diagrams, roentgenograms, and numerous photomicrographs. The manuscript is well written and contains references to the best literature on the subject, including notably the works of Nicols and Richardson, Fisher and Ely.

There are several typographical errors, and some of the roentgenograms are upside down. Many of the roentgenograms do not reveal what the legends indicate, due, undoubtedly, to loss of detail in reproduction. The colored illustrations of gross pathological changes are not as good as the microscopic colored plates. Examination of the illustrations with a magnifying glass is helpful especially of the photomicrographs. It does not help very much in examining some of the roentgenograms.

This book can be recommended very highly. It should be of value to orthopedic surgeons, pathologists, and internists.

PHILIP LEWIN

THE *Text-Book of Neuro-Anatomy*,² by Professor Albert Kuntz, is designed to introduce beginning students to the subject. It will not be as useful to the advanced student or clinical man as the author's book on the autonomic nervous system. An attempt has been made to acquaint the reader with the simplicity of the fundamental plan of the vertebrate nervous system and to build upon this ground-work only what the author considers the essential details of neurology. Although most of the chapters are very brief and skeleton-like in lack of detail, those on the cerebrum and possibly the cerebellum are written rather more in full. In criticism of the text

¹DIAGNOSIS IN JOINT DISEASE. A CLINICAL AND PATHOLOGICAL STUDY OF ARTHRITIS. By Nathaniel Allison, M.D., F.A.C.S. and Ralph A. Ghormley, M.D. New York: William Wood and Company, 1931.

²A TEXT BOOK OF NEURO-ANATOMY. By Albert Kuntz, Ph.D., M.D. Philadelphia: Lea & Febiger, 1931.

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AMERICAN COLLEGE OF SURGEONS

THE WRITING OF SCIENTIFIC PAPERS IN THE PERIOD OF OPPORTUNITY

“THE practicing surgeon has little time for the writing of papers.” The truth of this statement, made by a recent visitor to the College Library, is evidenced by the large number of men highly esteemed in their communities who have never found time to organize series of cases and make a careful study of interesting phases for the benefit of men throughout the medical world who are working on the same problems. However, the professional man who has material and records of value and who appreciates the advantage of a detailed and exact knowledge of the progress of others is ready to share his own experiences and results, and to set aside the time required for preparing and presenting the material in suitable form. Many who, until now, have found their days too crowded with the more pressing responsibilities of their professional life may during the present health ‘moratorium’ (declared of necessity by at least a portion of the lay public) find time to undertake the task which has hitherto been postponed. In this period of opportunity, if we will but regard it as such, the services of the Department of Literary Research can be of assistance.

Diversity of requirements The Department of Literary Research was planned to meet the varied needs of Fellows of the College and other members of the profession in the preparation of their scientific papers. Whatever the need of the writer may be, the Department is ready to supply it. If it is desirable to know the number of tumors reported, similar to the unusual one which has recently come to operation, and details of the history, pathological report, and classification in each case, the Department can make the necessary search. If the exact details concerning the origin of a new type of treatment are desired from the literature of 5 years ago, the Department will compile the bibliography and abstract the data. If a brief reference has been noted to experimental work which is described in detail elsewhere, the Research Department can help in locating it. If, further, the article is written in a foreign language, it can be translated by the Department. Whether

it is necessary to know what was written two hundred years ago or what is being published in a foreign land today, this staff of experienced workers is prepared to obtain the information, thus lessening the burden of time and labor required to search for the material which, together with the doctor’s daily experience, is the basis for the study of his present case and the background for his paper.

Personal service It is the aim of the Department to serve each Fellow as completely and satisfactorily as though he were immediately available in an adjacent office for conference and advice. Accordingly each person sending in a request is asked to outline his requirements as definitely as possible. The *subject of research* is to be stated fully and the *type of work* desired, i.e., “bibliography alone,” “bibliography and abstracts,” or a “translation of a single article (reference enclosed).” In outlining a request for a *bibliography* it is important to indicate the number of years to be covered by the research, i.e., “two years,” “ten years,” or “back to the beginning of the use of this type of treatment.”

If *abstracts* and *translations* are desired it is advisable to state which phases of the subject are of interest. For example, an article may contain a discussion of the history, etiology, pathology, symptomatology, diagnosis, differential diagnosis, treatment, prognosis, end-results, experimental work, or any combination of these factors. The one making the inquiry may be interested only in treatment and prognosis. Thus a complete translation of any one article might contain much extraneous material and but little of real interest to the inquirer. If the entire article is in point, a complete translation can be furnished, if not, a brief paragraph will inform the inquirer of the nature of the article and in a general way of its contents.

The Department is interested in knowing the *date at which the material is to be completed* so that the report will reach the inquirer in ample time for his needs. Here, again, it is wise to be specific. It is more satisfactory to the doctor and to the

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THE RÔLE OF BILE IN HIGH INTESTINAL OBSTRUCTION

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THE necessity of administering saline in intestinal obstruction to maintain the fluid balance and replace the chlorides lost by vomiting is now very well established. Hartwell and Hoguet noted the importance of maintaining the fluids, but Haden and Orr were the first to realize the vital rôle played by the chlorides. Cooper has recently published a thorough review of the literature on intestinal obstruction. The cause of death in high simple obstruction still remains obscure, but the work of White and Fender seems to indicate quite conclusively that no toxin is produced in the intestine above the obstruction, for they kept an obstructed animal alive 28 days by restoring through an ileostomy below the point of obstruction the materials lost in the vomitus. Armour and his co-workers in this laboratory have recently studied very exhaustively the chemistry and bacteriology of dogs in acute obstruction and conclude that death is not due to toxæmia or to the presence of bacillus welchii but to chemical changes. One animal of theirs, obstructed 2 feet below the pylorus, was kept alive 50 days by the administration of saline and glucose-peptone solution at the end of which time continuity of the intestinal tract was successfully re-established.

With such striking results as these, it might seem that the problem was nearly solved. But why is death so much more rapid when the obstruction is just below the level of the

entrance of the bile and pancreatic ducts than when the obstruction is above the ducts or lower down in the jejunum? Is it necessary that the biliary or pancreatic secretions should be reabsorbed or be in contact with the mucosa of the lower intestinal tract? Wilkie suggests that "the essential difference between the high and the low obstruction would appear to be the loss of all the digestive secretions by vomiting which attends the former and which is but a late event in the latter." Brockman claims the most phenomenal results clinically from the treatment of intestinal obstruction by the administration of bile by rectum, saying that in most cases, after the first rectal injection of human bile the vomiting ceases, the pulse rate is lowered, the drawn, anxious expression fades rapidly, the dry furred tongue becomes moist and clean, the restlessness is abolished, and the abdominal distention disappears. His report is based on only 13 cases so treated, but, in a recent personal interview, he says he has used the treatment successfully in 50 cases and is convinced of its value. Operative procedures are, of course, employed as well. No experimental evidence has been brought forth to substantiate Brockman's findings.

The present work has been carried out with a view to determine, if possible, the part played by bile in high intestinal obstruction. Meyers and Rosenblatt gave human bile to obstructed dogs through an enterostomy below

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Department to plan for the completion of the material before March 30 1932 than to work with the less definite date as soon as possible in mind

An *appropiation* for the work should be indicated also. The package library service (selected reprint material from the College files) is without charge to Fellows of the College. The work of compiling bibliographies abstracting and translating is done at cost and hence a definite appropriation for each piece of work should be made. The Department will then supply as much material as is possible for the amount specified (or less) and if additional data is desired the limit of

expenditure can be raised after the first report has been received. It should be borne in mind that not even the terms comprehensive or limited service will mean the same thing to all people at all times.

The College Library will supply blanks for the convenience of those desiring to outline research. However a definite statement of the requirement of the doctor is the factor of importance. Whatever the need may be connected with the writing of a scientific paper it is the purpose of the Department to render assistance—that all may share in the benefits to be derived from the preparation and study of each.



Fig 1 Anatomical arrangement after cholecystenterostomy and obstruction of intestine at tail of pancreas. Left hand loop with portion of abdominal wall attached indicates enterostomy opening

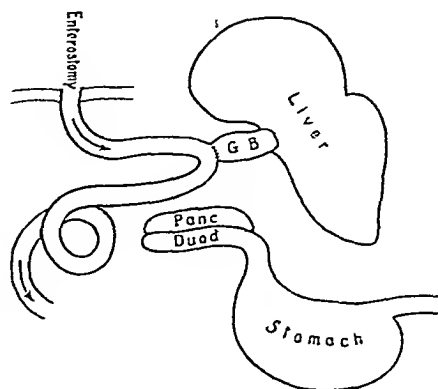


Fig 2 Diagram to show arrangement in Figure 1

method (Rosenthal) but was found to be normal in the control animals as well as in those getting bile below the obstruction. Hence the length of survival of the animal after obstruction appeared to be the only means of judging whether the animals receiving bile were doing better than their controls. This again is not an altogether satisfactory criterion, for large or fat dogs under these conditions of obstruction plus starvation probably live longer in most cases than do small or thin dogs. A great deal of experimental work has been done on starvation in animals. According to Morgulis, "the loss in weight is greater the smaller the animal, and this rule holds good not only for representatives of different groups but also of those belonging to the same species." He also says, "the greater the store of fat in the body at the commencement of the fast, the longer can the privation of food be endured and the greater may be the relative loss sustained. The literature on fasting abounds in instances of body losses of 50 to 60 per cent and even greater losses which various animals, both cold blooded and warm blooded alike, have suffered before death from starvation occurred." The length of time which dogs can survive starvation varies enormously in different dogs, Morgulis giving 38 days as the average period but the limits as 21 to 117 days. The record fast of 117 days was reported by Howe, Mattill and Hawk, in a Scotch collie, which was fed at the end of this long fasting period and recovered completely. Such

catheter introduced into the gall bladder, brought out through a stab wound, and attached to a balloon with a side-arm arrangement for drawing off the bile. Such animals usually eat well and live quite a normal existence for about 2 months, gradually losing weight and eventually succumbing, as Whipple has shown, to intestinal disturbances, or, if fed on a special diet of liver, or bread and salmon, they may live 4 to 10 months, dying with advanced bony abnormalities due to loss of inorganic salts.

DEDUCTIONS

The problem in the experiments reported herewith has been to find some criterion by which to judge what good, if any, was accomplished by administering bile through an enterostomy below the site of obstruction. In several animals liver function was tested by the intravenous tetrachlorphenolphthalein

the obstruction but none of their animals lived long enough to indicate that bile was of any particular value. Jenkins short circuited the biliary pancreatic and duodenal secretions into the bowel below the point of obstruction keeping such animals alive 12 to 33 days. The operative procedure was complicated the obstruction relatively low allowing for an absorption of water and some food taken by mouth and death was apparently due to the gradual fall in blood chlorides, rise in plasma carbon dioxide capacity and non protein nitrogen content. These experiments were not conclusive as to the part played by the biliary pancreatic and duodenal secretions for dogs with high obstruction not fed getting saline only by enterostomy below the obstruction have been kept alive for equally long periods. Matsukura reports such a dog obstructed just below the bile and pancreatic ducts kept alive for 33 days by saline only.

EXPERIMENTAL METHOD

Dogs were obstructed at varying levels from just below the bile and pancreatic ducts to 11 inches below this point. Some of these animals received normal saline and dogs bile collected from a dog with a permanent cholecystostomy other dogs by a preliminary cholecystenterostomy with ligation of the common bile duct done a week or more before obstruction of the intestine received their own bile below the level of the obstruction. The anatomical arrangement in such an animal is shown in the accompanying photograph and diagram (Figs. 1 and 2). Still other dogs obstructed at the same level to serve as controls received saline only. Nothing was given by mouth except a very occasional sip of water. Obstruction was effected by severing the bowel completely inverting the proximal end and either bringing out the distal end to the abdominal wall through a stab wound to serve as a feeding enterostomy or inserting a Pezzar catheter into the distal end and bringing that out through a stab wound. When the bowel itself was brought out through the abdominal wall as a permanent enterostomy an ordinary catheter was inserted once a day for administration of saline or saline bile. The difficulty with this method was that in some

cases a reverse peristalsis occurred causing leakage around the catheter. The other method also presented difficulties such as irritation of the abdominal wall where the catheter passed through an attempt of the animal to remove the catheter and in one case perforation of the intestine from irritation of the Pezzar catheter within its lumen. It was found by experience that 70 cubic centimeters of normal saline per kilogram of body weight daily was sufficient to maintain the blood chlorides and the carbon dioxide combining power at normal level. This amount was administered in divided doses half at about 9 a.m. and half at about 5 p.m. Thus a 10 kilogram dog would receive 350 cubic centimeters in the morning and 350 cubic centimeters again in the afternoon. The blood chlorides and carbon dioxide combining power were determined in every case just before death in order to make sure that death was not due to insufficient chlorides but routine daily or even weekly determinations were found not to be necessary. The animals were kept in metabolism cages so that it was certain that their fluid intake exceeded their output. In Armour's work it was found necessary to increase the intake up to 2,000 or even 3,000 cubic centimeters daily in order to maintain the fluid balance. It seems likely that such an enormous intake was necessitated in his animals by the aspiration of gastric contents two or three times daily which was carried out to prevent contamination by vomiting. Such aspiration was not carried out in the present series the dogs being left to vomit their secretions. Continued aspiration apparently stimulates the gastric mucosa to marked hypersecretion. The accompanying photograph (Fig. 3) shows the method of feeding by enterostomy. The saline or saline bile was kept at constant temperature in the electric thermostatically controlled water bath and ran into the dog's intestine by syphon through the tubing and catheter. The rate of flow was observed through a glass drip tube as shown in the photograph and averaged about 500 cubic centimeters in an hour. Dogs from 11 to 15 kilograms in which the common bile duct had been ligated and a Pezzar



Fig 4 Alert attitude of Dog 2 after 37 days of intestinal obstruction

difference in the level of the obstruction. It could not be said that the bile received by Dog 2 below the obstruction was a factor in his survival 44 days, when Dog 3, without bile, survived 58 days.

Figure 4 illustrates the alert attitude of Dog 2 after 37 days of obstruction. The level



Fig 5 Stomach and intestine of Dog 2, removed at autopsy to show the level of the obstruction



Fig 6 Extraordinary activity of Dog 3 after 56 days of intestinal obstruction

of obstruction is shown in Figure 5. Similarly the extraordinary activity of Dog 3 after 56 days of obstruction is shown in Figure 6, this dog would not remain quiet long enough for a good photograph to be taken. Figure 7 illustrates the stomach and level of obstruction in this dog.

As no definite conclusions regarding the use of bile could be drawn from these three dogs, it was decided to obstruct a series of dogs, all at exactly the same level, just below the entrance of the bile and pancreatic ducts, some

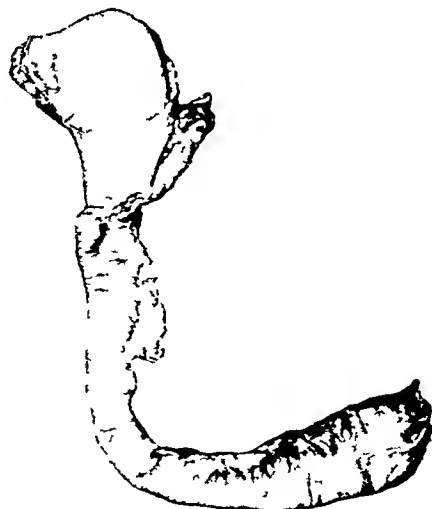


Fig 7 Stomach and intestine of Dog 3 removed at autopsy to show the level of the obstruction.



Fig 3 Method of dog by 1 1 my

fasts as these indicate that there are other important factors at work besides starvation when the intestine is obstructed at a level just below the entrance of the bile and pancreatic ducts for animals so obstructed and treated with saline only below the obstruction have never been reported as surviving more than 33 days. In a small fat fox terrier (9.84 kilograms) of this series however obstructed 15 inches below the pylorus (or 11 inches below the ducts) the survival period on saline treatment alone was 58 days. From a search of the literature this appears to be the longest survival yet reported of any obstruction at so high a level and death here may well be attributed to starvation. At higher levels however with death coming on the twenty eighth to the thirty third day at the longest there must be additional factors besides starvation and simple obstruction. Obstruction 11 inches below the ducts must give opportunity for absorption of gastric duodenal biliary and pancreatic secretions obstruction just below the ducts gives no oppor-

tunity for absorption of these secretions. There appears then to be a critical point in this region below which obstruction may be tolerated to the point of starvation but above which obstruction is not tolerated to the point of starvation. Table I illustrates results in this series.

From Table I it will be seen that in these three dogs the higher the obstruction the shorter the survival regardless of weight or bile. The heaviest animal obstructed higher than the others died sooner. The lightest animal obstructed 7 inches lower down lived over twice as long as the heaviest neither animal receiving bile below the obstruction. The lightest animal was in fact a very fat one which no doubt explains in part his good showing. Dog 2 obstructed at a level about half way between that in Dogs 1 and 3, lived longer than Dog 1 but shorter than Dog 3. Dog 2 received 80 to 100 cubic centimeters of fresh dog's bile daily in normal saline, the total fluid intake calculated on a basis of body weight to correspond with that of Dog 1. During the last 4 days of life Dog 2 received 5 per cent glucose in normal saline plus bile. The glucose may have prolonged his life 2 or 3 days. Dog 3 received relatively nearly twice as much saline as did Dogs 1 and 2. It was thus seen that these three dogs were not strictly comparable with one another partly perhaps because of their difference in size and amount of fat but chiefly because of the

TABLE I—RESULTS IN FIRST SERIES

Weight	Amount of bile below ducts—Inches	Length of survival—Days
1	15	58
2	11	44
3	7	22
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TABLE II—RESULTS IN SECOND SERIES

Dog	Weight in kgm	Amount of fat	Level of obstruction	Length of life after obstruction—days	Received bile below obstruction
4	6.7	Average	Immediately below ducts	24	No
5	13.6	Fat	Immediately below ducts	7	No
6	12.6	Average	Immediately below ducts	29	No
7	10.4	Average	Immediately below ducts	36	Yes—cholecyst enterotomy

TABLE III—CHEMICAL FINDINGS

Dog	Days after obstruction	Blood CO in vols %	Blood chlorides in mg %	Blood N P N in mg %	Blood cholesterol in mg %	Urine chlorides in gms %
1	23	70.5				
2	44	47.0	600	35		
3	58	42.0	583	36	154	
4	24	58.0	534			
5	27	89.0	466		172	
6	29	74.0	448		140	
7	36					0.38

structed, this is a finding of some interest. Throughout the period of obstruction there was a steady loss of cholesterol in the feces and, in some cases, in the bile. The results, therefore, though incomplete since they do not take into account the body tissues, tend to support the view that the animal body possesses the power of synthesizing cholesterol.

Another phase of the problem was also considered in these dogs, namely, are there any changes in the bile itself after intestinal obstruction? It has been observed clinically that when patients with intestinal obstruction vomit green material containing bile they are usually progressing favorably, such vomitus may be regarded as "healthy" vomitus. When the vomitus becomes brownish in color, however, the patient's condition is usually much less favorable. To study such possible changes in the bile itself, cholecystostomy was performed in two dogs, the bile collected daily, and analyzed for bile salts and cholesterol content during periods of normal feeding, starvation (when water was freely allowed), and after high intestinal obstruction (when normal saline was administered by enterostomy below the obstruction). The percentage bile salt as taurocholic acid was estimated by the method of Smith, Groth, and Whipple. The charts (Figs 8 and 9) indicate the changes in the amount of bile secreted, bile salt and cholesterol content, under these varying conditions. The amount secreted was, of course, less during starvation and continued to decline, on the whole, as long as starvation continued. The cholesterol content of the bile from Dog 10 remained remarkably constant throughout the experiment, while that of Dog

11 rose somewhat just before obstruction and continued so for a few days after obstruction. The bile acids showed quite a marked drop after obstruction in Dog 10, but soon rose again, remaining, however, at a slightly lower level during obstruction than before, and somewhat lower also than subsequent to its relief by posterior gastro-enterostomy. In Dog 11, on the other hand, the bile acids rose for several days after obstruction. The color of the bile was also observed grossly, and although it was usually brown, it became quite green at times. No unusual change in the pigment was visible, however, as a result of the obstruction. It would appear, therefore, from the results in these two animals that intestinal obstruction produces no change in the cholesterol, salt, or pigment content of the bile, for whatever changes were noted in one animal after obstruction did not occur in the other.

CONCLUSIONS

When obstruction of the intestine is so high that no bile can be reabsorbed, the experiments suggest that benefit is derived from administration of bile below the obstruction.

In obstruction well below the bile papilla, where some reabsorption of bile is possible, there is probably no special advantage to be derived from the exhibition of bile.

While these experiments would appear to indicate that a lack of bile in the segment below the obstruction is not a factor of fundamental importance in determining the fatal issue in obstructed dogs, they do not preclude the possibility of benefit being derived from the use of bile in the lower bowel in the human subject suffering from paralytic distention.

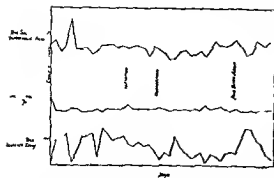


Fig 8 Dog

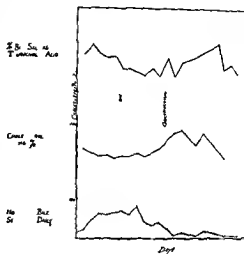


Fig 9 Dog

of the animals to serve as controls and some to receive bile below the obstruction. To avoid the necessity of having cholecystostomy dogs to provide bile preliminary cholecystenterostomies were done on several animals so that when obstructed later they would receive their own bile below the obstruction. Figures 1 and 2 previously referred to illustrate this procedure. Table II indicates the results obtained.

In this series it is seen that the dogs not receiving bile below the obstruction lived 24 to 29 days; such survival periods are longer than the average reported in the literature for dogs obstructed at this level receiving saline only below the obstruction. The dog receiving its own bile by cholecystenterostomy below the obstruction outlived by 1 week any of the controls in this series and any other comparable control previously reported in the literature, with the exception of one dog reported by Matsukura. His dog, an animal of 14.5 kilograms obstructed just below the pancreatic ducts by daily injection of 2,000 cubic centimeters of normal saline into an enterostomy below the obstruction, lived 33 days. Our dog was 4 kilograms lighter in weight and received relatively very much less fluid per day (only 700 cubic centimeters) but lived 36 days. This result, it seems to us, while not striking, would tend to show that in obstruction just below the entrance of the ducts bile may be of some help in prolonging the life of a dog. Further observations are intended in this series to confirm this point but the other animals died unfortunately from apparently unrelated causes.

Table III indicates the chemical findings in the dogs so far reported.

Generally speaking, the blood analyses recorded in Table III gave results within normal limits. In only one case, Dog 5, was there evidence of an alkalosis, and this was hardly severe enough to be regarded as evidence that the animal died of the alkalosis dehydration characteristic of acute intestinal obstruction. This conclusion is supported by the observation that the blood chloride, though near the lower limit of the normal range, was not abnormally low.

Further support is afforded by the figures for non-protein nitrogen, which were definitely normal in contradistinction to the high figures so often, though not necessarily obtained prior to death from intestinal obstruction.

In two dogs the terminal carbon dioxide combining power was actually below the normal range. It is significant that these animals had survived 44 days and 58 days of obstruction respectively and that both showed acetoneuria. The light acidosis therefore may justifiably be regarded as the result of starvation.

The blood cholesterol was invariably within the normal range and especially a individual dogs showed no tendency to a fall in blood cholesterol during the time they were ob-

A METHOD FOR THE PLASTIC RECONSTRUCTION OF THE COMMON BILE DUCT

AN EXPERIMENTAL STUDY

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SINCE the advent of biliary tract surgery, plastic reconstruction of the common bile duct has merited and received much attention in surgical literature. Very complete reviews of the methods employed in such work have been published by Walton, Eliot, and others. Because of these complete reviews the methods which have been employed will be mentioned only briefly.

Sullivan and McArthur have advocated reconstruction of the duct around a soft rubber tube. If the ends of the duct could not be approximated, they used omentum and adjacent tissue to fill in the defect. Excision or resection of the obstructed portion of the common duct with end-to-end union has been long employed (12) but frequently either due to retraction of one end of the duct or masses of adhesions, this is impossible. Giordano and Stropeni reported the use of a segment of vein to fill in the defect in the common duct. Experimental work with this procedure by Horsley threw rather unfavorable light upon the method. Segments of fascia lata were used by Lewis and Davis with equally unfavorable results. Moynihan suggested the use of the jejunum in the same manner as the gastroenterostomy of Roux. In the hands of Horsley this was quite unsuccessful. Kehr introduced the procedure of puncturing the actual liver substance with the cautery and anastomosing an opening in the bowel to the defect thus produced. This procedure has also failed in the hands of many. According to Walton, Molénius suggested the use of the appendix to replace the common duct. He attempted the operation only on cadavers. Lattin and Pettinari report the use of hardened guinea pigs' trachea to fill in common duct defects, a method that has obvious objectionable features.

When the gall bladder is present, the well established operations of cholecystogastrotomy or cholecystoduodenostomy may be

utilized to side track the flow of bile. Judd and Beaver have reported ascending biliary tract infection in patients following such operations. Gatewood has shown experimentally that ascending biliary tract infection almost invariably follows such procedures in dogs. The supposition is that this ascending infection is due to regurgitation of gastro-intestinal contents into the biliary passage through the patulous stoma. Therefore an operation more nearly re-establishing a normal common duct is to be desired.

Williams, Lilienthal, Lahey, and Walters have reported a considerable number of cases in which an external biliary fistula has been dissected loose and transplanted into the stomach or duodenum. This seems to be the method of repair most in favor at this time. Naturally the production of such a fistula and subsequent transplantation makes the procedure one of multiple operations.

We have worked out experimentally an operation for reconstruction of the common bile duct which we feel overcomes many of the objectionable features of previous operations and which may have a field of clinical application. Briefly our method is this: A viable tube from 1 to 2 inches in length is constructed from the mucosa and submucosa of the anterior stomach wall. This tube may be anastomosed to the gall bladder, common or hepatic ducts. The operation is one stage and experimentally has been quite successful.

We have found no operation described in the literature embodying in detail this principle. Walton and Mayo used pedunculated flaps from the stomach or duodenum to piece out small defects on the anterior wall of the common bile duct but did not, so far as we could tell from their articles, attempt the construction of a tube from such flaps.

We believe the ideal operation for the reconstruction of the bile duct should have the fol-

The composition of bile with respect to the bile salts and the cholesterol content is apparently not altered by intestinal obstruction

When the chloride and water balance is maintained the length of survival of an obstructed dog seems to depend almost entirely on (a) the exact level of the obstruction below the bile papilla and (b) the fat reserve

The following table shows the results of the experiments of the author and his co-workers in the study of the effect of intestinal obstruction on the composition of bile and on the survival of the animal.

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d. g. aft. pyl. d. testinal. b. tru. t. J. Exp. M. d. 93. 55. 5. H. 11. J. A. d. H. J. P. F. pe. m. t. i. t. tin. I. b. t. t. th. pecial. ef. nc. t. th. ca. se. f. death. d. th. t. timent. b. large. am. ts. f. mal. li. l. t. J. Am. M. Ass. 9. li. 8. 6. Ho. P. E. M. TILL. H. A. d. H. P. B. J. Bol. Ch. m. 9. 7. J. S. XI. H. I. Expe. m. 3. tal. l. A. h. S. g. 99. XIX. 7. 8. M. URA. S. Ch. m. l. t. d. li. and. th. t. ss. t. tinal. b. t. t. t. J. pa. J. M. Sc. 93. 9. M. E. M. P. d. R. E. BLATT. M. S. Bl. in. testin. l. b. t. t. S. g. Gynec. & Ob. t. 99. I. 43. M. G. 11. S. F. t. g. d. U. d. V. t. n. N. w. Y. k. E. P. D. tt. & Co. 93. R. THAL. S. M. Th. ph. It. t. achl. rphth. l. t. t. f. k. f. ta. J. Am. M. Ass. 9. Sm. m. H. P. G. A. H. d. Wur. G. H. Bd. It. m. t. b. l. m. J. B. L. Ch. m. 98. l. xx. 659. 3. W. G. H. O. g. d. gnu. 6. f. tt. t. f. bl. Ph. y. l. R. 9. p. 44. 4. W. J. C. d. F. F. A. Th. ca. f. d. th. m. pl. cat. d. high. nt. tin. l. b. t. t. A. h. S. g. 93. 895. 5. W. KI. D. P. D. A. t. testin. l. b. t. t. B. tol. M. Ch. J. 93. l. 97.

exposure, the gastrohepatic ligament, a tense and firm structure, which seems to hold the stomach and duodenum in place, is nicked with scissors and subsequently stripped down with the index finger. Promptly thereafter, the pylorus and duodenum, as well as the pyloric end of the stomach, seem to come up about an inch or more very readily into the abdominal wound. The pyloric segment of the stomach is exposed for a distance of $2\frac{1}{2}$ inches and clamped between two stomach clamps (Fig 1), the latter may be introduced through the omentum from below upward. The anterior muscular wall of the stomach is incised from the lesser curvature to the greater, transversely and midway between the two clamps. By the same caution required in the Rammstedt operation, we promptly reached the mucosa and submucosa, which bulge in a characteristic fashion. The edges of the divided musculature are spread by blunt dissection (Fig 2), until a sufficient flap $1\frac{1}{4}$ inches wide is exposed. A rectangular flap is cut out (Fig 3) about 1 inch wide with the base toward the lesser curvature. All of the dissected mucosa is not used for the flap, since it is important to have a free mucosal edge for repairing the gastric defect later. The tailored flap is reflected upward and is held up with Allison forceps (Fig 4). The flap is then made

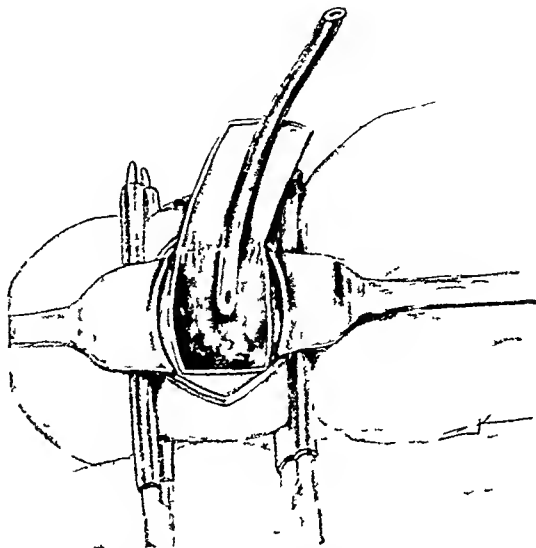


Fig 4. The flap of mucosa turned back and the catheter, about which the flap is tailored to form a tube, is in place

into a tube by stitching its free edges to each other over a catheter or a glass rod (Figs 5 and 6). In making the tube, a single continuous suture of silk is used, the stitches being taken closely and the edges of the mucosa being turned in after the method of Lembert. The thickness of the tube is made up of mucosa, muscularis mucosa, and some loose cellular tissue between it and muscularis. It contains nerves and blood vessels, coming in from the lesser curvature. The tube thus made is covered with a wet pad and is set aside for the time being. Later, on removing the stomach clamps, the viability of the tube is evidenced by oozing of blood. The defect in the stomach wall is repaired with silk or specially prepared catgut for gastro-intestinal surgery. The edges of the separated mucosa and submucosa are united by turning the edges in, so as to avoid the suture material hanging into the lumen of the stomach. The muscles are next united in a definite way. Two stitches are carefully placed, one above and one below the base of the tube, thus forming a sort of muscular cuff around the basal circumference of the tube. The stitch above the tube is passed through the muscle on one side, then horizontally through the connective tissue of the tube, then through the muscle on

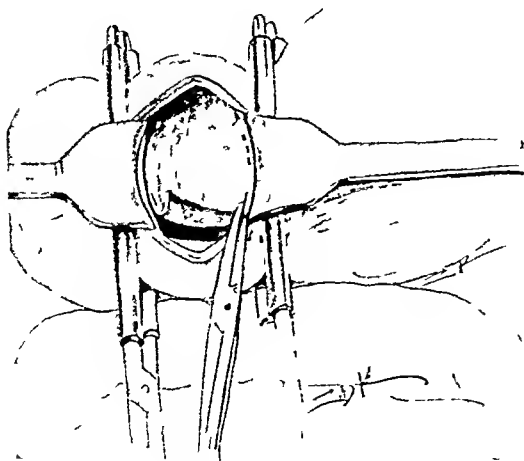
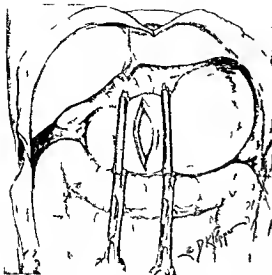


Fig 3. The preparation of the flap of mucosa to be used in making the gastric tube which is to serve as a duct. Note that the blood vessels supplying the flap come in from the lesser curvature.



Fg Th l mp th t m h j tp un l
t th pyl phi t d th t th h n thr gh th gu
l Th t rse h n thr gh th sa
d m sc l t Th m sa b lg f rw d

lowing requisites (1) tubular reconstruction the tube being lined with epithelium and spanning some distance between the gall bladder and the gastro intestinal viscus (2) epithelial contact at point of anastomosis (3) absence of inabsorbable suture material in lumen which may induce infection or incrustation with bile salts (4) freedom from tension upon anastomosis (5) anastomosis between the gall bladder or duct with gastro intestinal tract so constructed that a viscus biologically receptive or immunized to bile contact is produced (6) reproduction in some manner of the valvulosphincteric mechanism at the distal end of anastomosis which should prevent infection of the liver and biliary passages (7) tubular reconstruction which should conform as much as possible to the anatomical obliquity of the tube in the wall of the gastro intestinal viscus. The value of a new method must be judged in the light of these qualifications.

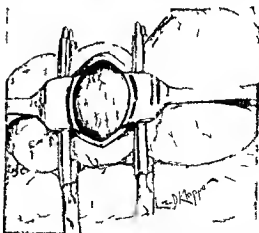
The survey of all the procedures to date has convinced us that an ideal operation for the reconstruction of the common duct is not yet at hand. We were thus prompted to experiment further in the hope of improving the previous methods. As will be seen from the description of our technique we attempted to

enforce most of the principles which we have mentioned as requisites for a suitable operation.

EXPERIMENTAL STUDIES

Dogs of large and medium sizes were used. The animals were prepared in the usual way for laparotomy. In addition the dogs were put on a milk diet for 2 days prior to the operation. Some of the animals were anesthetized with ether others with nembutal (Abbott). If anesthetized with ether the dogs were given a quarter of grain of morphine 1 hour before the operation and 1/20 grain of apomorphine. In this way we always found the stomach clean at the time of operation. If nembutal was used morphine was eliminated and 1/20 grain of apomorphine was given shortly before the operation. Nembutal is administered intravenously 25 to 33 milligrams per kilogram of weight. It induces an instantaneous general anesthesia which is quite satisfactory in character and lasts from 2 to 4 hours.

A pararectal incision is made from the costal margin down to the level of the umbilicus about 1 inch to the right from the median line. The abdomen is opened in the usual manner the edges of the skin being fastened by towel clips to sterile towels. The stomach is delivered in the abdominal wound. To facilitate



Fg Th m sa b d dissected f f m th mus-
l t th d f th cu io Th m sa posed
bo t y nch wid d t d f m within } nch f
th l see rv t l l h f m th g eat curv t re.

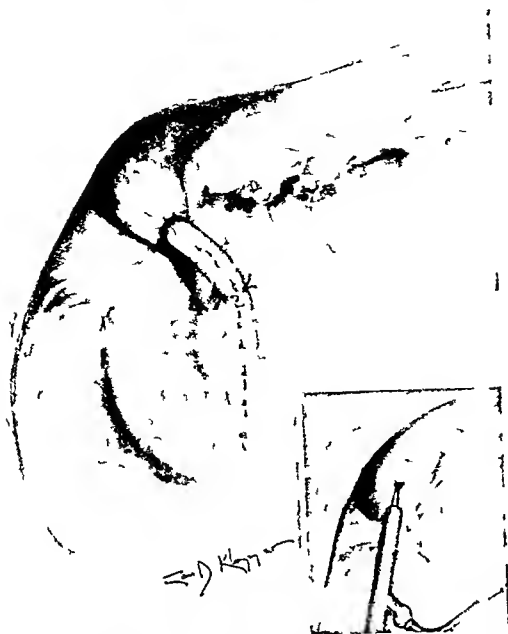


Fig 7 The gastric tube anastomosed to the gall bladder. Note the "cuffing" of the gall bladder on the tube.

passes through the mucosa it may become incrustated with bile pigment and calcium salts. One of these dogs (Dog 2) died at 2 weeks due to distemper and a small leak at the "gall-bladder tube" anastomosis.

In 4 dogs the anastomosis was made by turning the edges of the gall bladder inward by placing interrupted mattress stitches (silk) through the serosa of the gall bladder and the connective tissue of the outer wall of the tube a little way from the mucous edge. This causes the end of the tube to project slightly into the lumen of the gall bladder and the gall-bladder wall to fit "cuff-like" over the tube (Fig 7). This is the best method, since no suture material is exposed to bile contact, and since the "purse-string" effect of a continuous suture is avoided.

In 2 dogs the gall-bladder anastomosis was made with a catheter in place. The catheter extended about $\frac{1}{4}$ inch into the gall bladder and 2 inches into the stomach. When the catheter is used, no bile pigment appears in the urine, whereas if the catheter is not used, the postoperative oedema of the tube causes jaundice for 3 or 4 days. X-ray photographs in these dogs show that the catheter passes

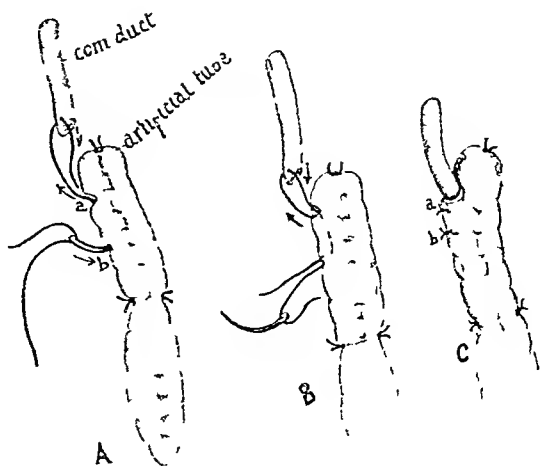


Fig 8 The method used to anastomose the gastric tube with the common bile duct. It is to be noted that the end of the gastric tube is entirely closed and a "button hole" the size of the duct is made. *a* A needle with silk suture is passed through the wall of the tube at *b*, then out through the button hole, *a*, through the duct and then back through the button hole, *a*, and out through the wall at *b*. Of course, if the stump of the common duct is dilated, as occurs in obstruction, it might be possible to do an end to end anastomosis between the duct and gastric tube.

from the artificial tube into the stomach in a few days and may be found in the faeces within a week or 10 days. In 1 dog (Dog 8) obstructive jaundice was produced 2 weeks previously by ligating and sectioning the common duct. Then our operation was performed, the catheter being left in place, with immediate relief of the jaundice.

To meet the contingency of reconstruction of the common duct in the absence of the gall bladder, the hepatic end of the common duct was anastomosed in several dogs with the gastric tube. In dogs the procedure is somewhat tedious, on account of the smallness of the duct, however, the operation is quite feasible and was performed on 2 dogs. The cut edge of the hepatic end of the duct is grasped with a hæmostat and dissected free for $\frac{1}{2}$ inch. A stitch is then passed from the outside of the gastric tube into and then out of the upper end of the gastric tube, then, the same stitch is passed through the outer wall of the duct just above the hæmostat and about $\frac{1}{4}$ inch from the cut edge and then passed back into the open end of the gastric tube and then through

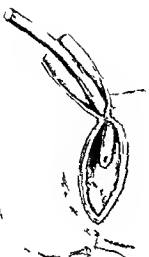


Fig 5. Common duct anastomosis.

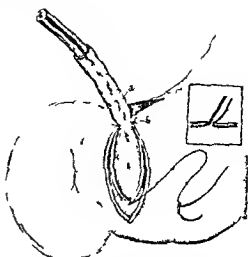


Fig 6. The tube is completed and the duct is then anastomosed to the common duct. The inset shows the method of suturing the tube to the common duct.

the other side. This stitch when properly placed invaginates the mucosa of the tube which acts as a valve (inset Fig 6). The remainder of the muscular defect is closed with a single row of continuous sutures. The original catheter used for shaping the tube being still in place is pushed into the stomach to test the patency of our tube toward the gastric cavity. The catheter may then be removed or permitted to remain in place and its upper end to project into the gall bladder when the anastomosis is made. When the latter is done the tube passes into the stomach and then per anum in a week or 10 days.

The common duct is next brought up and divided between two linen ligatures to produce an obstruction. The gall bladder is exposed and picked up at suitable points by two Allison forceps. The bile is aspirated with a syringe (inset Fig 7) and once emptied it is brought forward toward the abdominal wound. (We believe that the gall bladder in man is more easily mobilized than in dogs and also that the thickness of the wall of the human gall bladder makes for easier and safer surgery.) An incision one fourth of an inch long is made in the gall bladder thus exposed. The artificial gastric tube is reflected upward and anastomosed to the opening in the gall bladder by one of several methods to be described

presently. The upward reflection of the tube gives it a certain obliquity and accentuates the valve like structure of the gastric orifice of the tube produced by the stitches above described thus imitating the normal anatomical obliquity of the common duct in the duodenal wall. The muscular cuff around the base may exert a sphincter like action during peristaltic activity of the stomach.

Before describing the various methods of anastomoses it is fair to say that dog surgery like all surgery depends upon the individual skill of the operator plus an intimate knowledge of dogs' tissues and general anatomical relations which are important factors in the ultimate success.

In 3 dogs the anastomosis of the gastric tube to the gall bladder was made as in the classical gastro enterostomy the edges of the gall bladder and gastric tube being united with either silk or specially prepared catgut for gastro intestinal surgery. Experience has shown that edge to edge contact using catgut on the tube is not a safe method as the tube pulls out or leaks at one or more points giving rise to bile peritonitis. Also if a silk suture

of the stomach is more narrow than the tube itself due to the intentional infolding of the wall of the tube by the stitch taken at the operation. The folds of mucosa covering the gastric orifice of the tube suggest that they might play a role in preventing the passage of gastric contents into the gastric tube and gall bladder (Figs 9 and 10)

Our other dogs will be chloroformed in 1 or 2 years and a complete report of the bacteriological and histological findings will be made

THE REASON FOR THE NEW METHOD AND ITS ADVANTAGES

The excuse for a new method of reconstruction of the common duct is based upon the conviction that all the procedures up to the present time either carry too great risk or are unsatisfactory within a short time after operation or a more or less remote period thereafter, and upon the desire of the research worker to attempt to improve upon the past. With very few exceptions, the present methods are subject to stenosis, leakage leading to bile peritonitis or fistula, stone formation, sloughing, and, lastly, ascending infection which is followed by immediate or remote hepatic sepsis.

The question might be raised why we did not use all layers of the stomach in making our tube. As a matter of fact, this was our original idea, but on performing the operation in our first dog we found that in order to bring the muscle layers together a large defect had to be made in the stomach wall and a tube relatively large in diameter had to be made. The thickness of the muscular wall of the pyloric antrum adds to the difficulties. We did not think it physiological to use the wall of the fundic portion of the stomach because its mucosa secretes hydrochloric acid—pepsin which would injure the mucosa of the biliary passages. The mucosa of the pyloric antrum is much more physiological, since it secretes only mucus.

The artificial common duct or gastric tube method described above we believe has the following merits: (1) the operation requires no greater skill, nor does it consume more time than any of the known operations for this purpose, (2) the anastomosis is made with non-pathological structures, (3) the artificial tube spans the distance between the gall blad-

der or bile duct and the stomach, in duct fashion, and lessens the possibility of ascending infection, (4) the artificial tube enters the stomach wall obliquely and has a muscular cuff at its base, imitating the normal anatomical scheme of nature, as in the case of the normal common duct, (5) the gastric tube is lined with mucous secreting epithelium, biologically immune to bile contact, (6) epithelial contact, support of the submucosa, and continuous bile drainage prevent stenosis at the point of anastomosis, (7) absence of inabsorbable suture material in the lumen prevents the possibility of future stone formation, infection, or ulceration.

SUMMARY

A new method for the plastic reconstruction of the common bile duct is described. A viable tube from 1 to 2 inches long is made from a flap of pyloric mucosa. This tube may be anastomosed to either the gall bladder or a biliary duct. The gastric orifice of the tube is constructed to prevent regurgitation. The operation has been performed successfully in a number of dogs without postoperative complications appearing within a period of from two to three months. The merits of the procedure are pointed out.

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Fig 9 Ph tog ph f th g tri rific f th gast
t b f D g k lled m th ft th p t Th
w p int t th rific hich has bee d ed p t t
by m t l p b (th light pot)

Fig Ph tog ph f th g l l b l d d f f th gas-
t t h f D g b th g t f e f w b ch sh 12
Fig 9

the wall of the gastric tube. As this suture is tied, the bile duct is drawn into the open end of the gastric tube. Two stitches are then taken between the edges of the open end of the gastric tube and the bile duct. A modification of this technique consists in closing the mouth of the gastric tube and pulling the hepatic end of the bile duct through a button hole on the side of the gastric tube (Fig 8). Before the abdomen is closed the omentum is placed about the gastric tube.

We have at the present time 8 dogs living from 1 to 3 months in excellent general condition and free from jaundice. Six of the dogs have a gall bladder anastomosis and 2 a common duct anastomosis. Three dogs died as a result of the operation: 1 at 2 weeks due to distemper and a leak at the gall bladder anastomosis; 1 at 2 days due to necrosis of the distal end of the gastric tube; and 1 at 3 days due to a leak at the gall bladder anastomosis.

Four dogs have been given a barium meal. X-ray plates and fluoroscopy with and without vomiting induced by apomorphine failed to reveal a reflux of barium into the tube and gall bladder. We found no evidence of regurgitation in the animals studied and apparently the orifice of the gastric tube at its stomach end possesses a valve like action.

Of course the orifice of the gastric tube may be entirely competent in preventing passage of gastric contents into the gall bladder but it may not prevent the occurrence of an ascending infection of the biliary passages. We shall follow our dogs for a year or longer and ascertain whether or not an ascending infection occurs.

The following autopsy record on Dog 6, etched June 18, 1931, 2 months after the operation reveals no ascending infection and an excellent postoperative result.

Whe th bd m n p ned th m t m
f nd dbe t t the g tri t b Th l
g ly norm l appe e Th g l l b l d d
d by th f e edg f th adj t l be
f th l r a d tai ed bil Th all f th gall
bladd lightly th ck d b t t s m c s a
orm f p pea Th ana t m t m
th g l l b l d d e t l k h pe d m t t d
p be 3 m l l met s i diam te C m p l t e h l
ghad cu d By d e t g th p b b l q d y
t p a ed eadly t the m ch Th g t t b
t kan b l q c bet en th g l l b l d d r d
th tom b and measu d j ch l g th The
gnal l g th f th t b app m t l y
ch s Wh th t m h p d th t t
f d t be b l e t ed b t h m c s a s
m l t b g b t Th g t e f f th g t r c
t be f d t b e ft s f d t b loc t f
d p e s ed d m p d l t b t n t f l d f
p y l m c s a l t d m t t d s gly r b 3 m l l
m t r u diam t r The g t r t b th th l l

OBSERVATIONS ON EXPERIMENTAL SPINAL ANÆSTHESIA

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A FAVORABLE early reception of a new clinical method may in itself prove a handicap. The methods, born in the clinic, which encounter from the outset the most bitter opposition can attain an accepted position only by abundantly justifying their right to an existence. Those on the other hand, to which initial popularity comes relatively easily, may rest upon insecure foundations. The very enthusiasm with which they are received may be their undoing. It is notable that most anæsthetic agents have been used in the human before we have had a proper conception of the mechanism of their action. When success attended its early use the agent has been accepted. Later with additional data regarding its action, its indications and limitations may have had to be greatly altered. Spinal anæsthesia is no exception and Leriche has recently remarked that "it has been the misfortune of spinal anæsthesia never to have interested the physiologist." Our concept of its action rests largely upon a rationalization of clinical observations. The literature of the subject contains very few sound experimental studies.

The earliest recorded attempts to secure surgical anæsthesia by blocking nerve roots were those of Corning, a neurologist, who in 1885, injected cocain between the vertebræ. The anæsthesia produced was undoubtedly due to epidural cocainization. Subsequently the introduction of the method of lumbar puncture by Quincke prepared the way for further progress. Bier, in 1898, reported a series of 6 cases in which spinal or subarachnoid anæsthesia was used for the first time in clinical surgery. Bier and his assistant also tried the method on each other and described their sensations accurately and illuminatingly. Two years later Tuffier and Halhon reported experiments in which dogs were anæsthetized by cocain through a cannula in the subarachnoid space. They observed a fall in blood pressure which was associated with vasodilatation. They contended that the action of the

drug was central since peripheral stimulation of the blocked splanchnic nerves produced an elevation in blood pressure. They assumed that the site of this action was on the nerve roots, although neither they nor subsequent observers have been able to exclude some effect also upon fibers within the cord itself. Tuffier should be given credit also for standardization of the technique of spinal anæsthesia.

In spite of Tuffier's contentions, it was generally believed that the anæsthetic effects of cocain were due to systemic absorption. Heineke and Loewen, in 1906, gave the drug intravenously and intramuscularly without producing either anæsthesia or alteration of blood pressure. They showed further that more profound effects were produced by a given dose of the drug injected intrathecally with large amounts of solvent than when smaller quantities were used. This they interpreted as being due to a more rapid and extensive diffusion of the drug in the spinal fluid. Using a ligature about the upper thoracic cord, they noted mild effects following injections below the ligature but a profound drop in blood pressure and death of the animal when the injection was made above the ligature.

Smith and Porter injected novocain or tropacocain at various levels of the spinal subarachnoid space of the cat. They found that the maximal fall in pressure occurred when the drug was injected in the dorsal region. Since this is the level from which the splanchnic nerves originate, they attributed the fall in pressure noted to a paralysis of these nerves. The distribution of the drug was controlled, they maintained, by the volume of solution injected, the position of the animal, and the direction in which the injection was made.

Schiff and Ziegner agreed in accounting for the blood pressure depression on a basis of splanchnic paralysis. They divided the subarachnoid space into sections by means of

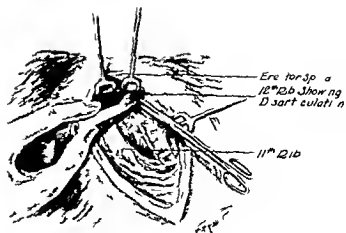


Fig Method of post-operative treatment

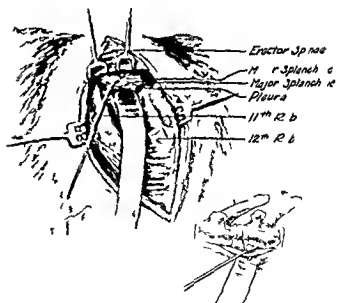


Fig Method of post-operative treatment

Observe the Effect of the 11th and 12th Ribs on the Pleura — L. K. or F. G. N.

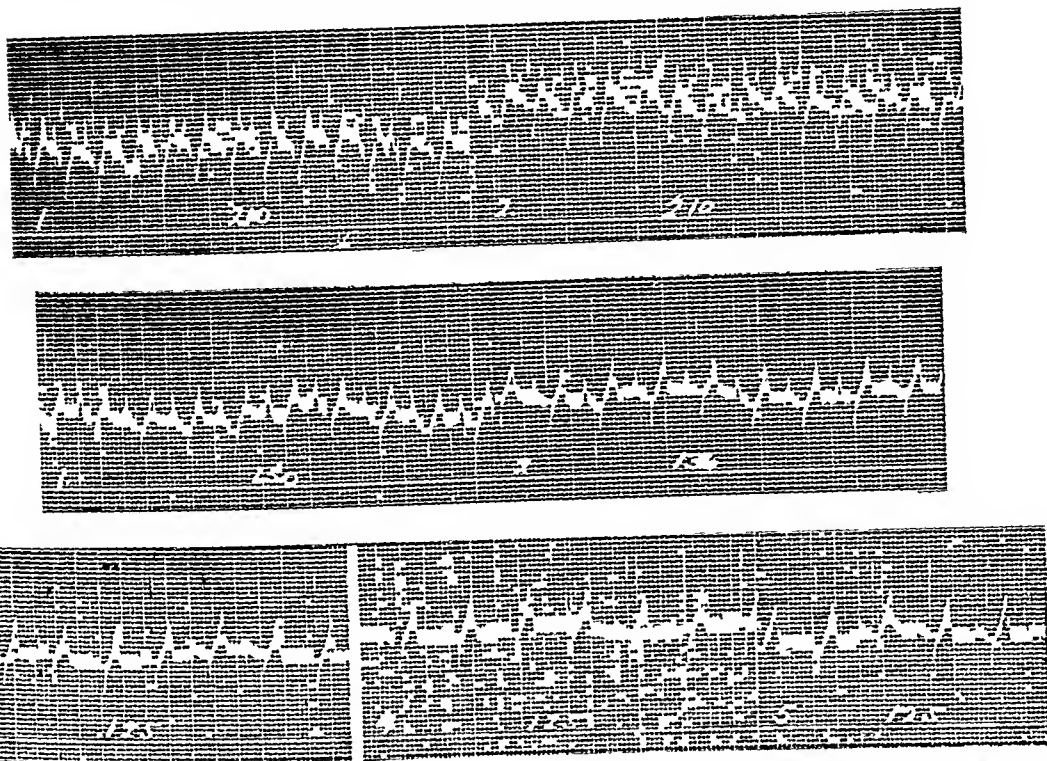
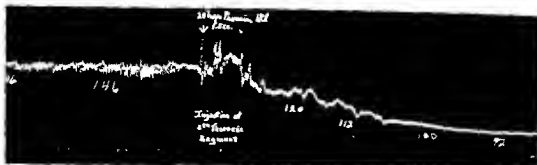


Fig 4. Electrocardiographic tracings showing the slowing of the pulse rate after the administration of a spinal anæsthetic A, top, Control records before anæsthetic (1) 3 minutes before injection, and (2) 1 minute before injection B, two lower graphs, After the subdural injections of 50 milligrams of procain hydrochloride (1) 4 minutes, (2) 6 minutes, (3) 9 minutes, (4) 16 minutes, and (5) 22 minutes after injection

of stimulation of their peripheral stumps. They found the depression of blood pressure following intrathoracic splanchnic section was comparable to that produced by division of the spinal cord in its upper cervical portion. The validity of blood pressure observations in unanæsthetized animals, shocked by extensive laminectomy and bilateral pneumothorax is questionable. Lefkowitz cut the splanchnics of the rabbit after a transperitoneal approach. Although he notes a vasodilatation of the mesenteric vessels he does not record blood pressure observations. Domenech notes a similar effect but protocols are lacking. Bunch observed an elevation of blood pressure following stimulation of the peripheral ends of the cut splanchnics but does not comment on the effect of the primary section. Ochsner, Gage, and Cutting have recently made a comparative study of the effects, particularly those on intestinal motility, of

splanchnic and spinal anæsthesia in dogs. They noted a much more profound depression of blood pressure with spinal than with splanchnic anæsthesia. It is seen that the authority for the statement that "division of the splanchnic nerves produces a profound fall in the general blood pressure" rests upon questionable grounds. It seems significant also that although clinicians speak glibly of the "splanchnic pooling of blood" with spinal anæsthesia, a gross engorgement of the mesenteric vessels has apparently not impressed itself upon operating surgeons.

The only other serious attempt to account for the stasis of circulating blood which must be associated with a lowering of blood pressure has been that proposed by Gray and Parsons and seconded by Featherstone. They suggested that it might be due to the accumulation of blood in the capillaries of the relaxed skeletal muscles. This theory fails to explain



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ligatures. They found the greatest fall in pressure compatible with life when the novocain was confined between the first and last thoracic segments. Injections made above the upper thoracic ligature caused death from respiratory failure.

Bower Wagoner and Clark also used the method of ligature at various levels of the cord. Their work was done on dogs and the drug used was stovaine. They noted the most profound depression of blood pressure in the cases in which injections were made into the cervical portion of the subarachnoid space. This depression was preceded by respiratory embarrassment and the authors, rejecting the splanchnic paralysis theory, conclude that the blood pressure alterations in spinal anesthesia are secondary to a central respiratory depression.

The remaining papers dealing with spinal anesthesia are clinical observations and discussions unaccompanied by original experimental data. Valuable as they are they contribute little to a fundamental understanding of the problems concerned.

The best papers summarizing the current concepts of the subject include those by Evans, Forgue, Moe, Sise and Isenberger. They have been concerned chiefly with the untoward reactions reported and the so-called spinal anesthesia fatalities. Leriche and Stout have worked out in detail individual techniques for the administration of the anesthetic and for their control. Labat has written extensively emphasizing the importance of control by altering the position of the patient

and of the dangers of cerebral anoxia. Delmas has organized. The general laws of spinal anesthesia. To Pitkin goes the credit for the present day enthusiastic revival of spinal anesthesia. By the preliminary use of epinephrin and gravity control of diffusion (by the use of a light alcoholic aqueous solution) he has repopularized the method in this country. Koster has boldly advocated the use of spinal anesthesia for all types of operations including those upon the head. He has hehlited the pre existing dread of low blood pressure levels. Babcock from a rich experience of 25 years of continuous use of the drug stovaine has presented valuable clinical observations. Most of these authors have accepted the doctrine that paralysis of the splanchnic nerves produces the characteristic drop in blood pressure. They talk of the pooling of blood in the splanchnic area and of a splanchnic relaxation.

The statement that division of the splanchnic nerves produces a profound fall in the general blood pressure is to be found in most physiological textbooks (Staring, Burton, Opitz, Bainbridge and Menzies). When this statement is traced to its source it is found to originate from the researches of Cyon and of Bezold and Bever. Their work was done upon curarized rabbits. It seems questionable to apply these observations unqualifiedly to man as has been done. The authors after severing the vagi depressor and cervical sympathetic nerves studied the effect on blood pressure of division of the cord at varying levels of division of the splanchnic nerves and

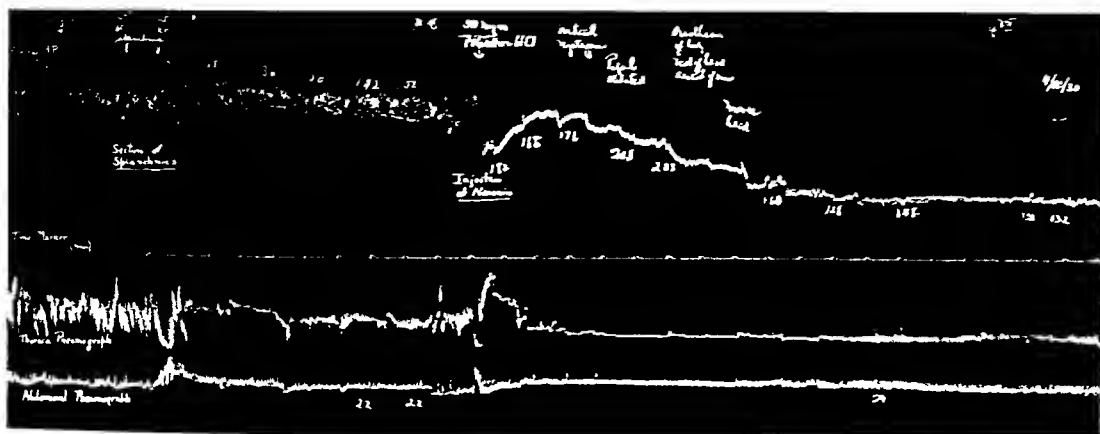


Fig 6 Tracing showing effect of splanchnic section and subsequent spinal anaesthesia on blood pressure.

nystagmus Great care was taken to avoid this accident, so invalidating to our observations. The tip of the needle was held against the arachnoidal surface of the meninges after having been thrust through the latter. The injection was then made gently under direct vision through the transparent membranes. Methylene blue was added to the solution as an aid to the accuracy of the injection. The colored solution could be readily observed diffusing along the subarachnoid space. In addition, by staining the tissues it defined the limits of diffusion. We assume that the diffusion of dye may be taken as an index of the diffusion of the drug. This may be incorrect. Certainly the concentration of the two at different levels will vary since their rates of absorption differ. Nevertheless, lacking an accurate qualitative test for the presence of novocain in small amounts of solution, we have been obliged to be content with this rough method of estimating its diffusion.

The drug used was novocain (procain hydrochloride) in the form of crystals dissolved in from 0.3 to 1.0 cubic centimeter of physiological saline solution. Whenever possible an equal amount of spinal fluid was aspirated into the syringe before injection. The dosage of novocain, chosen arbitrarily, was 30 to 50 milligrams.

Blood pressure was recorded on a kymographic drum by means of connection of a mercury manometer with a cannula placed

in the femoral artery. A time marker served as a base line.

Accurate pulse counts were not easy to obtain except in those experiments in which electrocardiographic tracings were made. Otherwise the pulsations of the mercury column or the fluctuations of the writing lever were counted by two observers simultaneously.

Respiratory excursions of the thoracic wall and abdomen were recorded by the use of inflated rubber cuffs strapped around the respective portion of the animal's body. The disturbance of the air within the cuff was transmitted to a tambour and recorded on the drum by a writing lever.

Splanchnic exposures In the experiments involving section of the splanchnic nerves, the latter were exposed on each side during the period of preliminary etherization. A silk ligature was passed around the greater and lesser nerves which were subsequently severed by traction upon the ligature. The splanchnic nerves receive fibers from the fifth to the twelfth thoracic sympathetic ganglia and often an additional ramus from the first lumbar. Their formation is not complete until just before they perforate the diaphragm. Immediately below the diaphragm branches are given off. Some of the highest of these go to the adrenals (Figs 1 and 2). Complete section of the splanchnics below the diaphragm is accordingly an uncertain procedure. We chose to isolate the nerves in their thoracic

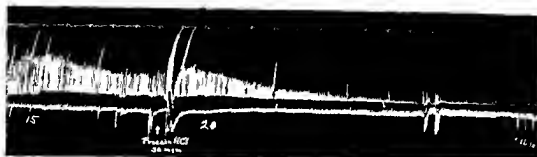


Fig 5 Tracing showing effect of spinal anesthesia and late increase of blood minimal (pharyngeal) in the late blood minimal in the

paratracheal depression of the thoracic respiration. Upper limit marks middle line of the chest.

why similar blood pressure alterations might not be encountered in the relaxed state of full ether anesthesia.

One final point merits discussion. Clinicians have long assumed that novocain affects sensory and vasomotor fibers more markedly than it does motor fibers. Accurate scientific proof of this specificity of action has been lacking until the publication of the recent brilliant researches of Gasser and Erlanger. These workers have studied the tracings obtained by photographing the deflections of a galvanometer string produced by an electrical impulse passing through a nerve fiber. The curve produced by such an impulse is characteristic and consists of several distinct waves similar to those of an electrocardiogram. Certain of these waves have been identified as due to motor impulses; others appear to be sensory in nature. A cocaineized nerve produced a tracing in which the motor waves remained intact but the sensory wave was obliterated.

The present research is an attempt to seek an answer to some of the heretofore inadequately established theories concerning the phenomena of spinal anesthesia. In particular our interest was centered upon the following: Is splanchnic paralysis responsible for the fall in blood pressure? If it is not, then what are the factors concerned? What is the mechanism of the slowing of the pulse rate? How is respiration affected? What is the primary cause of death from spinal anesthesia? How much protection is conferred by preliminary epinephrin medication? The scope of the

problem widened as the work progressed. We realized early that we should have to content ourselves with merely accumulating an infinitesimal amount of data in reply to many of the questions enumerated. The final solution of the entire problem awaits further investigation.

METHOD AND TECHNIQUE

In each experiment the necessary operative exposures were carried out under full ether narcosis. After all preparations were made inhalation was stopped and opportunity given for the dog to recover before proceeding to make observations. During this period and thereafter an anesthetist remained at the head of the animal to quiet it when necessary. Ether was chosen for this preliminary anesthesia in preference to any of the barbiturates because of the known antagonism of the latter to novocain.

The subarachnoid injection was made through a laminectomy opening ordinarily in the lower thoracic region using a curved needle of No. 20 gauge. We have been unsuccessful in attempts to perform lumbar puncture with certainty. Even after removing the lamina and spinous processes of two or three vertebrae the accurate introduction of the anesthetic solution into the subarachnoid space is a delicate manipulation. The central canal is thinly roofed over on the dorsal aspect of the dog's spinal cord. Injection into this canal or puncture of the cord itself produces a form of spinal shock characterized by progressive fall in blood pressure and

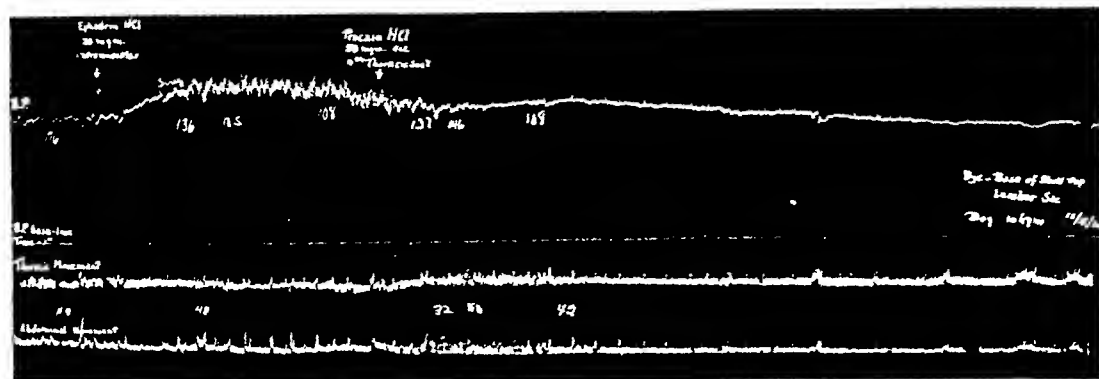


Fig 8 Effect of ephedrin hydrochloride, 2 milligrams per kilogram, given 10 minutes before subdural injection of anæsthetic drug

accompanying spinal anæsthesia in the dog are very similar to those observed in man. Our attention was concentrated upon observation of the alterations in blood pressure, pulse rate, and the type and amplitude of respiratory movements. There is typically a fall in blood pressure within 1 or 2 minutes of the introduction of novocain. The curve described by this fall may be precipitous or gradual. Often an immediate sharp decline is followed by a slow rise. The pre-anæsthetic level is not regained, however, until the effects of the anæsthesia have disappeared. In a series of 12 experiments (Table I) the average peak depression was 79.9 millimeters of mercury below the pre-anæsthetic level. This was a reduction of 51.8 per cent from the control level. In 6 of the 11 animals representing early experiments, the diffusion of dye was not checked. In this unverified group, the blood pressure alterations were not as profound as in those in which the level reached by the dye was known. There is reason to believe that the diffusion of the anæsthetic may have been less extensive in the former group, as these early injections were made through a lumbar rather than a thoracic laminectomy (Fig 3). The two are listed separately in Table I.

There was a retardation in the pulse rate accompanying the fall in blood pressure with only a single exception. The average minimal slowing was 42 beats per minute. In the single instance referred to, a primary injection of 50 milligrams of novocain apparently failed

to diffuse far from the point of injection. The typical phenomena did not appear (Fig 4). A second injection was made. This was followed by a pulse rate change from 200 to 125. There was also a decline in blood pressure and a typical respiratory effect, and autopsy showed a staining of the cord up to the eighth cervical level as a result of the second injection.

There was characteristically a striking effect upon the amplitude of thoracic respira-

TABLE I—EFFECT OF SPINAL ANÆSTHESIA ON BLOOD PRESSURE, PULSE RATE, AND RESPIRATION

Ex periment No	Dye diffusion	Blood pressure				Pulse rate decrease after spinal anæsthesia beats per min	Res piration effect of spinal anæsthesia on
		Before anæsthesia	After anæsthesia	Fall in mm. hg	Per cent fall		
34	C8	189	70	119	6+	40	Cessation
38	C8	152	53	99	65	77	Depression
32	C4	132	60	72	54	44	Cessation
61	C4	157	46	112	7+	50	Depression
37	C1	137	30	107	77	25	Cessation
22	Unchecked	149	63	86	5+	22	Cessation
23	Unchecked	143	19	64	4+	3+	Depression
24	Unchecked	156	78	78	50	6	Depression
45	Unchecked	137	72	65	46	36	Cessation
33	Unchecked	170	136	34	20	42	Depression
36	Unchecked	218	150	68	31	44	Cessation
39	Unchecked	143	94	49	36	30	Depression
Average				79.9	51.8	41.7	

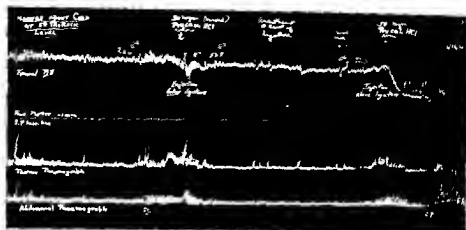


Fig. 7. Effect of spinal anesthesia when fixed to case before fifth thoracic segment by a ligature.

portion making a dorsolateral approach without opening the pleural cavity. An incision is made parallel with the twelfth rib the overlying muscles being divided but the long paravertebral muscles being retracted mesially. The twelfth and usually the eleventh ribs are then divided about 2 centimeters lateral to the costovertebral articulation and resected subperiosteally back to this articulation. The deeper portions of this and subsequent dissections are greatly facilitated by the use of a lighted brain retractor and an electric light mounted upon a head band worn by the operator. The parietal pleura is separated from its attachment over the transverse processes toward the bodies of the vertebrae until the greater and lesser splanchnic nerves are exposed. A special small curved aneurysm needle is used to pick up the nerves which usually are found adhering to the pleura enclosed in fat. Tearing of the pleura at this stage should be avoided by extreme gentleness in dissection. A small rent may be tamponed but pneumothorax is poorly tolerated by the dog. The method has been used for some time in this laboratory.

Ligation of the spinal cord. In experiments in which it was desired to place a ligature about the cord laminectomy was done at the appropriate level and a silk ligature was passed around the dura by means of an aneurysm needle. The ligature was tied later when

the animal had practically recovered from etherization. This ligature must be snug enough to obliterate the subarachnoid space but must not produce compression of the cord. Little difficulty was experienced from this source in the thoracic region. In cervical ligations however spinal shock was produced by the trauma of even the most gentle manipulations of tying the ligature. Eventually we were successful in overcoming this difficulty by the use of a special clamp. The lowermost bar of a Hoffman clamp was perforated. The two ends of a piece of umbilical tape which had been passed around the cord were threaded through this perforation. The ends were then made fast to the movable central bar of the clamp. A very delicate adjustment of the ligature without undue trauma to the cord was then possible by manipulation of the set screw.

Autopsy control. At the completion of each experiment autopsy was performed. The meninges were opened to determine the extent of diffusion of the dye. The cord was transected at several levels to rule out penetration of the central canal. The competency of ligations and the complete severance of the splanchnics were verified as the case might require.

RESULTS

A Characteristic phenomenon of experimental spinal anesthesia. The phenomena ac-

existing after splanchnic section of 61 per cent. A comparison of these figures with those obtained in animals with intact splanchnics indicated that these nerves exercise only a minor rôle in the maintenance of the general blood pressure level, provided at least that the balance of the vasomotor system remains intact. The blood pressure curves obtained in this group are shown by a chart.

C *Anæsthesia confined below the mid-thoracic level contrasted with complete diffusion.* This group of experiments represents an attempt to ascertain which portion of the spinal nervous system is chiefly concerned in the production of the phenomena previously described as typical of experimental spinal anæsthesia. A ligature was placed around the meninges at about the level of the fifth thoracic spinal segment. The subarachnoid space was thus divided into two compartments. Within the lower one arise the nerve roots carrying vasomotor fibers to the splanchnics and also the somatic distribution to the abdominal wall and the lower extremities. Within the upper compartment originate the remaining vasomotor elements of the sympathetic system, also the cardiac accelerator nerves and at least half of the motor intercostal nerves (Fig 7).

Four animals were used in this manner. Novocain (50 milligrams) was injected below the ligature. The average maximal fall in pressure noted was 20.5 millimeters or 15 per cent from the pre-existing level. In two instances a second injection of novocain was made and no further depression was obtained.

The pulse rate was accelerated 76 and 60 beats, respectively, in 2 of the experiments. In the 2 others there was a transient retardation of 60 and 35. This slowing was followed by a return to the control rate before additional injections were made. Thoracic respiratory excursions were slightly impaired in one experiment but unaffected in the remainder. Owing to the fact that the ligature in these animals was situated in the midcostal region, some of the intercostal motor fibers were exposed to the action of novocain, whether injection was made above or below the ligature. Accordingly the respiratory effects might easily be irregular.

Novocain (30 to 50 milligrams) was then injected above the ligatures. The average fall in blood pressure following this procedure was 45 millimeters or 38 per cent from the level obtained after the injection into the lower compartment.

The pulse rate was definitely and permanently slowed in every instance by these high injections. The slowing was, respectively, 128, or 20, and 105, or 25 beats per minute.

The thoracic respiration was uniformly depressed by the injections into the upper compartment. In the instance in which some slight diminution in movement had already taken place, there was additional depression.

In a single animal, a primary injection was made into the upper compartment to observe the effect of such an injection with a pre-existing normal blood pressure level. In this animal the pressure fell 82 millimeters, or 67 per cent. This phenomenon points to some penetration of novocain into the spinal cord itself with resulting interruption of some superficially located vasomotor fibers destined to leave the cord at a lower level. The same explanation holds for the summation of effects noted with anæsthesia of the cervical portion of the cord, which will be described in a subsequent section.

D *The influence of a peripherally acting vasoconstrictor drug.* Since the vasomotor effect of novocain is upon the nerve roots, it seems logical to attempt to offset the vasodilator tendencies by the use of a vasopressor drug the point of action of which is peripheral. As early as 1903 Klapp and Doenitz independently used epinephrin in the solution of cocaine used for anæsthesia. They considered that the blood pressure depression resulted from the systemic absorption of cocaine and the addition of epinephrin was an attempt to retard absorption. Ockerblad and Dillon were probably the first to propose ephedrin as a prophylactic peripheral vasoconstrictor in spinal anæsthesia. The popularity of this addition to the technique of anæsthesia is due to the teaching of Pitkin.

We have accumulated some experimental data bearing upon this aspect of the problem.

Ephedrin hydrochloride in a dosage of 2 milligrams per kilogram of body weight was



Fig 9 Effect of ephedrine hydrochloride 2 milligram per kilogram given intramuscularly after the blood pressure

tion. This was not noticeable until several minutes after the fall in blood pressure had occurred. One of two alternative changes then occurred. There was an abrupt cessation of all movement of the thorax, the breathing being purely abdominal or diaphragmatic in type. In other cases the diminution in amplitude of the thoracic excursions appeared gradually (Fig. 5). In reality the transition to an abdominal type of breathing was more striking than our tracings show. A reflection of the abdominal movements was registered by the thoracic pneumograph due to the flaring of the costal borders. Often there appeared to be a compensatory increase in the amplitude of the abdominal movement following anaesthetization. The rate of respiration was relatively stable.

B The effect of section of the splanchnics

Despite the general agreement among physiologists that division of these nerves brings about a profound fall in the general blood pressure our observations did not bear out this fact (Fig 6). In 5 animals the average maximal depression of blood pressure following section of all the splanchnic nerves was 17 millimeters of mercury. In at least one instance the maximal depression represents a transient initial level. The average ultimate depression measured 5 minutes after the division was only 11 millimeters. Spinal anesthesia was induced subsequently in 4 of these 5 animals. In each instance the typical profound blood pressure decline was encountered. The average of these was 77 millimeters or a percentage fall from the level



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n m thod / Blood pre c rv in which p al asth t was g b t ephedrin. // Blood p surr
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were not placed, so as accurately to delineate the entire area of origin of intercostal fibers

When a cervical compartment is created by a ligature placed at the level of the eighth cervical segment, anæsthetization of this region produces very striking phenomena suggesting a summation of the effects observed from action on other levels. In 3 animals there was an acute and immediate fall in blood pressure, averaging 77 millimeters or 57 per cent. The average retardation of pulse rate was 41.7. The depression of respiration was particularly noteworthy. The usual diminution in thoracic movements resulted soon after anæsthetization. From 5 to 11 minutes later, however, suppression of the abdominal movements supervened. Subsequent to this respiratory collapse, the heart ceased to beat. The cardiac action could be sustained and the blood pressure maintained at a fair level (40 to 60 millimeters) by immediate institution of artificial respiration as reported by Bower and associates. The abrupt termination of life by respiratory failure had not been observed in earlier experiments where lower injections were made and only minute concentrations of novocain penetrated to the cervical and medullary levels. The failure of respiration in this group of experiments clearly preceded the collapse of the cardiovascular mechanism. The lowest systolic pressure present at the time respiration ceased was 40 millimeters. This level had been found to be consistent with life and recovery in earlier experiments. The efficacy of artificial respiration is noteworthy.

CONTROL EXPERIMENTS

The specific action of novocain in interrupting impulses passing through nerve tissue is a logical explanation for its effect. Nevertheless, it was thought necessary to exclude other possible factors by a series of control experiments. The effects obtained might conceivably be due to (1) puncture of the meninges by the needle, (2) alteration of the cerebrospinal fluid equilibrium by the introduction of solution into the subarachnoid space, and (3) the absorption of novocain into the systemic circulation.

In 2 instances puncture of the meninges followed by the introduction of physiological

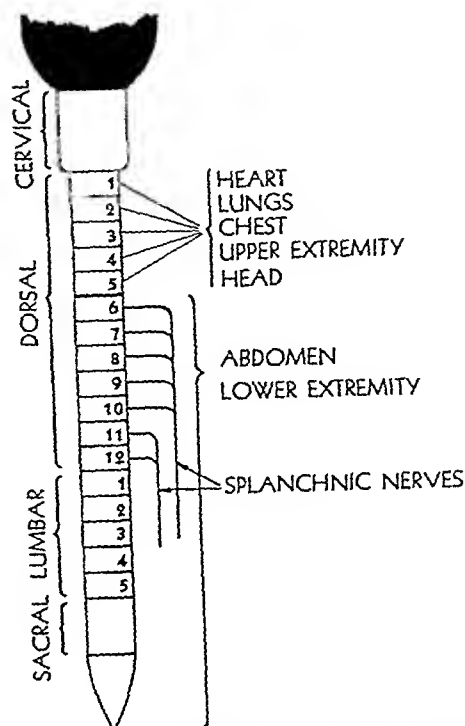
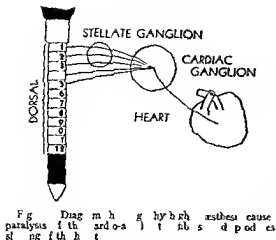


Fig. 12. Diagram of cord to show sympathetic nerves affected by injection of anæsthetic drug above and below fifth thoracic segment.

saline solution, in an amount equivalent to that used as a solvent for the anæsthetic, produced absolutely no effect upon blood pressure, pulse rate, or respiratory movements.

The factor of novocain absorption was then considered. The introduction of 200 milligrams subcutaneously and an equal amount intramuscularly were without effect. Novocain was then given intravenously. No anæsthesia was used in these animals other than a local infiltration to permit insertion of the femoral cannula. The dosage varied from 75 to 250 milligrams. The larger doses produced convulsions. The average fall in blood pressure observed was 2 millimeters and the greatest fall was 8 millimeters. The pulse changes were negligible, usually a slight increase occurring as a result of the manipulation. Respiration was not impaired.

When injections were made into the retroperitoneal tissues near the solar ganglion or retropleurally near the sympathetic ganglio-



given intramuscularly prior to the induction of spinal anesthesia. An average elevation of blood pressure of 17 millimeters of mercury was obtained at the end of about 10 minutes. The typical cataclysmic fall in blood pressure after spinal anesthesia did not occur (Fig. 3). There was some depression of blood pressure in all 4 instances but it was late in its onset and slight in degree. (The maximal depression in animals not receiving ephedrin occurred usually within the first 5 minutes.) In this group the average depression at the conclusion of this period was only 3.5 millimeters. At the end of 20 minutes the blood pressure in the ephedrinized animals had reached its lowest level in each instance. This was an average of 19.5 milligrams of mercury or a 13 per cent depression as compared with the figure of 51.8 per cent for animals who had not previously received ephedrin.

We have found that the optimum effects are obtained when ephedrin is given 10 minutes before the injection of novocain. If ephedrin is given after the blood pressure has fallen the intramuscular injection of ephedrin produces only a gradual elevation of the blood pressure (Fig. 9). Obviously this delayed effect is due to poor absorption of the ephedrin from the point of injection due to impaired circulation. An intravenous injection of ephedrin will rapidly raise the blood pressure at any time but this mode of injection in man at least must be regarded as reserved for great emergencies. This question of the

time at which ephedrin is given is of practical importance due to the wide spread custom of giving ephedrin at the same time as the anesthetic drug. Figure 10 gives a graphic representation of the behavior of blood pressure following ephedrin given in the various manners discussed.

The alterations in pulse rate in this group of experiments were inconstant. Twice ephedrin had no effect upon the heart rate but the characteristic slowing was observed after spinal anesthesia. In the 2 other animals a slowing of the rate of 28 and 16 beats per minute was recorded after the giving of ephedrin. After anesthesia these rates were accelerated 22 and 32 beats respectively. It may be significant that the final pulse rate in these 2 cases was still somewhat less than during the control period.

Observations of the respiratory movements showed a uniform transition to an abdominal type of breathing after anesthetization. The tracings give a fallacious impression. Apparently the abdominal excursions were exaggerated in these ephedrin experiments and a reflection of these movements was recorded by the thoracic pneumograph. Ephedrin would not be expected to have a pronounced effect upon respiration.

E. Observation with high injections of novocain. The action of the anesthetic may be confined to the upper thoracic region by placing two ligatures about the cord one at the eighth cervical and the other at the fifth or sixth thoracic level. In 3 such experiments uniform phenomena occurred. There was an average drop in blood pressure of 43 millimeters or 35 per cent. The pulse rate was uniformly slowed the retardation averaging 52 beat per minute. The respiratory effects were variable. In one no effect was observable in the tracing. The second showed a familiar gradual diminution in thoracic movements without impairment of the abdominal excursions. In the third although there was no evidence of leakage above the cervical ligature at autopsy respiratory failure occurred after 7 minutes in a manner to be described presently as typical of injections in the cervical region. Again the inconstancy of results may be explained on the basis that the ligatures

with a falling blood pressure is an intriguing phenomenon. One would suppose that some compensatory reaction such as the carotid sinus reflex would act under these circumstances to maintain the minute volume output of the heart by an acceleration in its rate. The fact that the rate is not increased but retarded is significant. A multiplicity of factors enter into the experiments to complicate their interpretation. Control pulse readings were taken during a period when the animals were excited by recovery from a general anæsthetic, and in addition pain impulses were being received from the laminectomy wound. Both of these factors would tend to elevate the pulse. After spinal anæsthesia the animals became quiet, and painful stimuli were interrupted. This does not, however, appear to be a complete explanation. The blood pressure and pulse curves run strikingly parallel, and there is a tendency for the pulse rate to return toward the normal rate in the experiment although the animal remains tranquil. The most obvious explanation for this apparently paradoxical phenomenon is a blocking of the cardiac accelerator fibers of the sympathetic (Fig 2). These originate from the first to the fifth thoracic segments (Kuntz). Interruption of these impulses would leave those arriving at the heart via the vagus unopposed. The resulting inhibition would then depend upon the degree of vagal tone existing in the particular animal concerned. This factor is known to vary. Attempts to study the reciprocal relationship by vagosection have not been conclusive in our hands. The theory presented obtains support from the evidence of those of our experiments in which we made use of a midthoracic ligature. When injections were made above the ligature so that the cardiac accelerator nerves were anæsthetized, a uniform slowing of the pulse was noted.

How is respiration affected? Our answer to this is that there are two separate and distinct effects of spinal anæsthesia upon respiratory movements. The distinction lies in the dual control exercised by the intercostal nerves, and the phrenics. When the intercostals are paralyzed, the phrenics carry on with an entirely adequate diaphragmatic type of breathing. When the phrenics, or it may be the

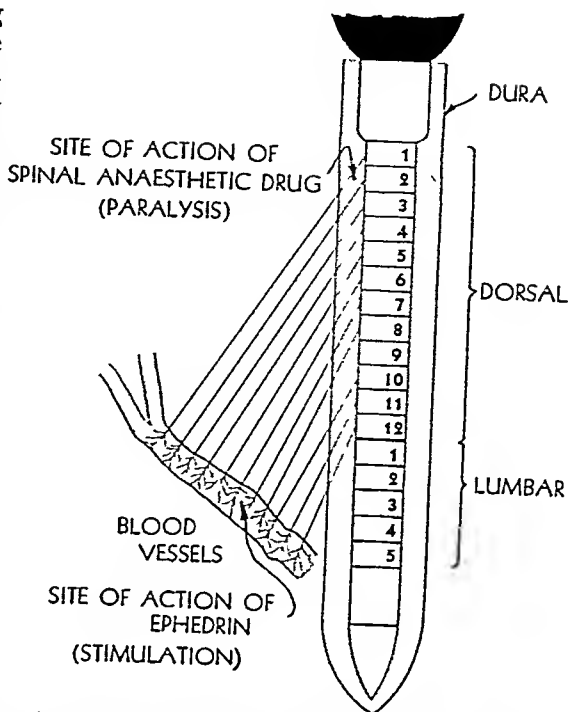


Fig 14 Diagram showing how peripheral vasomotor stimulant will counteract effect of central sympathetic paralysis in maintaining blood pressure during spinal anæsthesia

respiratory center itself, are anæsthetized, complete cessation of breathing occurs. The clinical analogue of the first effect named is the subjective sensation of suffocation or of oppression of which patients often complain. The analogue of the second is the dreaded "respiratory collapse." Ordinarily novocain does not diffuse to the cervical and medullary regions in sufficient concentrations to produce the more serious of these two contingencies (Fig 5). Our experimental results are in conformity with those of Bower, Wagoner, and Clark. Our interpretation of these results varies in that we do not admit that the explanation for all the alterations lies primarily in bulbar respiratory paralysis, except in those cases in which the drug reaches the upper levels in high concentrations. We agree with them, however, in emphasizing the value of the early institution of artificial respiration in cases of spinal anæsthesia catastrophe.

What protection is afforded by preliminary medication with ephedrin (Fig 14)? Ephedrin

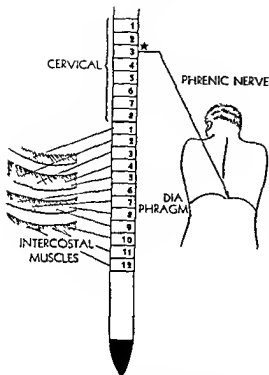


Fig. 3. E. t. f. int. r. tal. m. scles. and d. phr. gm. ★ R. pur. t. r. p. aly. oc. urs. nly. wh. ane. th. t. drug. r. h. th. rd. cal. segm. t. in. h. g. c. ce. trati. n.

nated cord a slight depression of blood pressure was observed. In these locations however there is ample opportunity for the drug to act directly upon vasomotor nerves. The fall in blood pressure observed was similar in degree to that obtained by section of both splanchnic nerves. These control observations indicate that the functional alterations in question are the result of the action of novocain directly upon nervous elements and that mechanical factors or systemic absorption are not responsible.

DEDUCTIONS

The extent to which observations made upon dogs are applicable to the human is always debatable. We have attempted to make our experimental conditions adhere as closely as possible to those of the clinic. Similar experiments cannot of course be performed on man. However the close analogy between the

observations herein recorded and those commonly noted in the clinic suggest that a quite liberal application is permissible.

Our experimental data offers an answer to at least some of the questions propounded at the outset. Is splanchnic paralysis responsible for the fall in blood pressure? Paralysis of the splanchnics alone with the resultant pooling of blood in the abdominal viscera appears to be only one of the factors concerned with the blood pressure alteration. It is certainly not the most important one. The evidence points to a participation of all the vasomotor elements in the maintenance of vasomotor tone and the degree of blood pressure depression resulting is in direct ratio to the number of white rami anesthetized. Section of both splanchnic nerves above the diaphragm results in only an 11 per cent fall in the general blood pressure. The total average fall in typical spinal anesthesia in an animal with vasomotor system including the splanchnics intact is 56 per cent. The full amount of this depression may be obtained by pinal anesthesia induced after section of the splanchnics. Furthermore when the anesthesia is confined by suitable ligature to the white rami supplying the splanchnic area plus the vasomotor elements to the lower extremities only a 19 per cent depression follows. Additional injection anesthetizing the rami having a higher origin produces an additional depression of 37 per cent. It is to be noted that the sum of these two approximates closely the percentage figure given for a typical unrestricted spinal anesthesia. By rough calculation therefore the part played by the various portions of the vasomotor system participating in the blood pressure decline may be estimated. One-sixth is contributed by the splanchnics, another sixth by the somatic fibers to the abdominal wall and the lower extremities (Fig. 11). The remaining two thirds are accounted for by a vasodilation in the upper extremities, the thorax and its contents and the head. The vasomotors of the lungs may play a large part. The variations in the circulatory bed of the lungs have never been adequately studied.

What is the mechanism of the slowing of the heart rate? A slowing of pulse rate associated

THE PRESENCE OF EPITHELIUM IN BLOOD CYSTS OF A TRANSPLANTED OVARY

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EPITHELIUM-LINED blood cysts of the ovary have been recognized as a pathological entity since the beginning of the century. Even with the first descriptions, e.g., that of Russell, the morphological similarity of the lining to the endometrium of the uterus has been remarked and emphasized. Investigations subsequent to that of Russell also have stressed this feature. Pick called the cysts adenoma endometriodes ovarii, Blair Bell designated them endometrioma, and Sampson has popularized the term endometriosis.

Sampson, in a series of excellent papers which command our admiration, sets forth considerations from which he deduced that the cysts arose from the implantation of material derived from the uterus onto the ovary and other organs in the peritoneum. A critical examination of his observations and deductions shows that the conclusions with regard to the nature of the cysts are obtained from a series of circumstantial observations, any one of which is not able to withstand close investigation.

One of the most important arguments raised is that transplantation of endometrial tissue, either accidentally during operation on human beings or experimentally in animals, results in the formation of blood cysts which are similar to those which are derived by implantation from ruptured ovarian epithelium-lined blood cysts. From the similarity of these two implants, it is argued that they are identical and therefore that the ovarian cysts are endometrial in origin. Even a brief contemplation of this reasoning shows its fallacy. The experiments with uterine mucosa are merely an example of growth of transplanted tissue such as occurs in many other cases, e.g., bladder wall, stomach wall, bone, and many other tissues. If the original tissues are similar—and this is generally recognized—then one would expect the implants of both to be similar. It does not necessarily indicate identity.

A decisive experiment, albeit accidental, is given in the following case. The transplantation of an apparently normal ovary was followed by the development, in the substance of this organ and from the ovarian structures, of blood cysts showing "endometrial" characters.

An unmarried female, aged 21 years, attended hospital suffering from attacks of severe lower abdominal pain. Her menses commenced at the age of 16. She had contracted gonorrhoea 2 years before seeking attention and had had many severe attacks of pain but these had been becoming less severe. She had had a miscarriage before her attacks of pain commenced. Her menstruation was usually normal, lasting 5 days, each 28 days, though recently it had been increased in amount. She had no frequency of micturition. Her previous history in other respects was normal.

On examination, there was found abdominal tenderness most marked in both iliac fossae. *Per vaginam* there was tenderness in the posterior fornix.

An operation, consisting of a left salpingo-oophorectomy and appendicectomy, was performed.

She continued to have pain particularly in the right iliac fossa. She gradually became worse and developed frequency of micturition and scalding.

On examination 4 months after the operation, she was tender and rigid over the right side of the abdomen and *per vaginam* there was marked tenderness in the right fornix. At operation, marked plastic peritonitis was found and a right pyosalpinx was present. There were no blood cysts present in the pelvis. A right salpingo-oophorectomy was performed by the electro-thermic method. The ovary, which contained a typical corpus luteum but no evidence of "endometriosis," was engrafted into the right rectus abdominis muscle. The graft was made since the ovary was regarded as being normal. The patient improved for several months, her menses continuing as usual. Almost a year after the operation the site of the implanted ovary became painful and swollen at the time of the menstrual period. This periodic swelling and pain continued for 3 months when the engrafted ovary was removed.

Pathological examination. The specimen consisted of a portion of excised skin, subcutaneous fat, and tissue containing a number of large blood cysts (Fig. 1). The specimen measured $1\frac{1}{4}$ by $\frac{3}{4}$ by $\frac{1}{2}$ inch. On gross section this tissue contained two large cysts filled with chocolate material and a few smaller cysts similarly filled. Around the periphery

given in adequate dosage at a sufficient interval before the induction of anæsthesia exerts a very profound effect in maintaining blood pressure at or near its normal level

CONCLUSIONS

Observations made upon dogs anæsthetized by the subarachnoid injection of novocain at varying levels permit the following conclusions

1 Accompanying a typical anæsthesia there is a fall in blood pressure averaging 56 per cent a slowing of the pulse rate and a diminution in the respiratory movements of the thorax

2 The fall in blood pressure cannot be explained on the basis of a splanchnic paralysis Division of the splanchnics produces only a slight alteration in the general blood pressure and the typical fall of spinal anæsthesia can be produced in animals with both splanchnics completely severed The entire vasomotor system participates in a vasodilatation and the degree of blood pressure depression is in direct ratio to the number of white rami anæsthetized

3 The fall in blood pressure may be greatly ameliorated by the vasoconstrictor effect of preliminary medication with ephedrin

4 The retardation of pulse rate is probably due to an interruption of impulses in the cardiac accelerator nerves

5 Paralysis of motor fibers to the intercostal nerves seems to account for the depression of thoracic respiratory excursions

6 Complete suppression of respiration occurs when novocain reaches the cervical portion of the cord and the medulla in sufficient concentration to paralyze the phrenics or the respiratory center itself

The wish to thank Dr. I. S. R. for his assistance in the experiments and Dr. F. S. W. for his assistance in the experiments and Dr. F. S. W. for his assistance in the experiments

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Fig 1 Semi diagrammatic drawing of the portion of tissue removed from the anterior abdominal wall, consisting of skin, fat, fascia, and muscle, and containing the ovarian graft which is the site of blood cysts

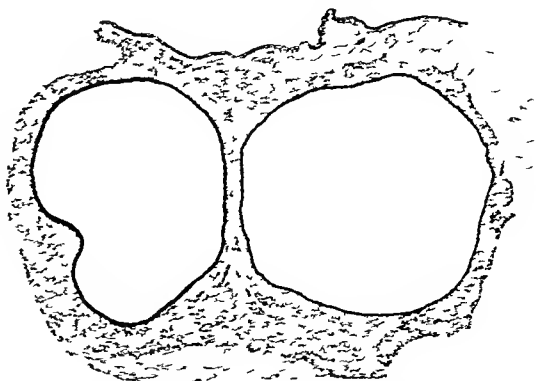


Fig 2 Drawing of a section of the tissue removed from the abdominal wall, showing the blood cysts with a thin layer of ovarian tissue in their wall, surrounded by fibrous tissue and fat and lying beneath the skin.

places large numbers of phagocytic cells containing blood pigment (Fig 8)

In other parts an epithelial lining has formed. This is mainly flattened (Fig 7), but in a few places cuboidal (Fig 9), and in some crypts it is columnar (Fig 10). A few epithelium-lined glands were to be found in relationship to some of the cysts. In these glands the epithelium was columnar (Fig 11).

Suppose we consider what one would expect if these cysts were of ovarian origin: (1) they should be within the confines of ovarian tissue, (2) they should be able to be traced to ovarian structures, (3) they should show changes similar to those seen in the abdominal ovary. All these criteria are fulfilled, so that there is

no doubt, even apart from the clinical and macroscopic evidence of "endometrial" glands in the graft, that the cysts are of ovarian origin.

Two problems remain, (a) the cause of the bleeding into these cysts and (b) the reason for the development of the epithelium.

The bleeding into the cysts was characteristically "endometrial." It occurred at intervals corresponding to the menstrual period and this was associated with swelling and pain. The reason for this is uncertain but is



Fig 3



Fig 4



Fig 5

Fig 3 Photomicrograph of portion of the wall of one of the cysts showing the small amount of ovarian tissue in the wall. Beyond this is ordinary fibrous tissue. $\times 110$

Fig 4 Another portion of the cyst showing the degenerated fibrous and hyalinized ovarian tissue. $\times 130$

Fig 5 Photomicrograph of portion of the wall in which there are remnants of follicular structures. The stratum granulosum has disappeared but the theca interna is well represented. $\times 180$

of the cavity of one cyst the blood was reddish as compared with the central artery of the chorion.

A microscopic examination of a section of the ovarian mass revealed ovarian tissue in small amount at the edge of the blood cysts. The ovarian tissue as compressed apparently by the increasing contents of the cysts (Fig. 3). The blood cysts were rounded (Fig. 4) and showed the structure of retrogressive follicles. Degenerated stromal tumorigenoma developed independently of the cyst wall (Fig. 5). In other places the layer of the degenerated stroma shown by the disintegration and disappearance of the cells of the placental trophoblast and fibrin tissue (Fig. 4). One cyst showed degenerated tissue in the wall (Fig. 6). Where the cyst walls were mainly fibrinous there was an epithelial lining flattened for the most part but in a few places cuboidal (Fig. 9) and columnar. Very little subepithelial stroma was to be seen. A few epithelial lined crypts (Fig. 1) and glands (Fig. 1) were present. The glands were related to the crypts and were confined to the ovarian tissue. Within the cysts was blood. Near the degenerated follicles were well preserved but farther from the degenerated blood was more homogeneous and the cells were well demonstrable. Around the cysts as the thin layer of ovarian tissue and around the smooth muscle and fat. Apparently some hemorrhage had occurred to the tissues surrounding the ovary. In some areas a few spaces containing blood and phagocytic cells were found.

An example such as this described is extremely valuable in the determination of the nature of ovarian blood cysts. Blood cysts may be found in the abdominal wall at the site of implantation of uterine mucosa but in the present case we have the occurrence of the blood cysts in the ovary after transplantation of the organ.

Two principal objections may be raised to the conclusion that the blood cysts are not uterine in origin. (1) uterine material may have been accidentally transplanted with the ovary or (2) the ovary may have been the site of endometrial implants at the time of transplantation. The first difficulty may be met by the observation that the graft was clearly recognizable and that the blood cysts were contained in its substance. At the time of transplantation the ovary was not treated in any way that could have introduced endometrial or tubal tissue. This is particularly certain since the electrothermic method was used in the removal of the tube and ovary. The second criticism cannot be met with ab-

solute certainty but a reasonable degree of accuracy may be expected from the clinical and operative findings and the macroscopic appearance of the ovary—all of which were negative for endometrial tissue. A corpus luteum was observed but no endometrial cysts.

We may therefore review the observations to be made in this specimen from the point of view that the lesions developed in the ovary after implantation. The specimen gives an excellent demonstration of the nature of the blood cysts.

In this specimen very little ovarian stroma is to be seen the greater part of it having been destroyed apparently by the pressure of the blood cysts. However a certain amount of ovarian tissue is to be found in the wall of the cysts (Figs. 3 and 4).

One of the cysts was an obvious atretic follicle in an advanced stage of retrogression. The stratum granulosum had almost disappeared but the theca interna cells were well marked (Fig. 5). It is to be remarked here that a thorough knowledge of normal and abnormal ovarian histology is essential in the examination of such specimens in order to recognize the characteristics and significance of these structures.

Other cysts and other portions of the same cyst present appearances in the wall that would render the determination of the origin of these parts from examination of them alone extremely difficult (Figs. 4 and 7). The presence of gradations from the obvious areas to those of doubtful nature just as occurs in the ovary in the normal situation enables their relationship to atretic follicles to be determined definitely.

Other features such as the luteal tissue in the wall of one cyst (Fig. 6) also give an indication of the nature of the blood cysts.

These cysts therefore are atretic follicles and in one case a luteal cyst into which bleeding has occurred and in which the retrogressive changes usual for such structures have taken place.

Some of the changes in the walls of these cysts are secondary to the presence of the blood. Pigment is to be found and in some

presence of blood pigment containing phagocytes, of absorption of the cyst contents. Since the epithelium occurs almost only in blood cysts undergoing retrogression it may be regarded as a functional differentiation of cells depending on the presence of blood in the cysts. However this may be, the evidence suggests that the epithelium is a reaction to the presence of blood in follicular cysts and is not due to transplantation of endometrial tissue.

SUMMARY

1 Blood cysts showing periodic bleedings and glandular development were found to arise in an ovary which had been transplanted into abdominal wall after salpingo-oophorectomy.

2 The cysts show "endometrial" characteristics, in that (1) they contained both old

and fresh blood, (2) they showed clinical evidence of periodic bleedings into their cavity, (3) they possessed, in part, an epithelial lining.

3 The cysts are demonstrated to be of ovarian origin and the epithelium-lined glands were intimately related with these and were confined to the ovarian tissue.

CONCLUSION

The fact that implanted endometrium will produce blood cysts cannot, therefore, be taken as evidence that cysts in the ovary which are superficially similar are of that origin.

I would thank Mr R Fowler F.R.C.S., for the case history and specimen from which these observations were made.



F 6



F 7

F 8



F 9

F



F 8

Fg 6 Ih t ms g ph f pot f th ll f y t
 hi bl al tiss us p s t Th p bly th
 mn t f th rp l t m h h b bly th
 p t X80
 Fg 7 Ph t m g ph f h d g t d p rt
 f ed f the y ts Th f th l l h g ll flat
 f ed X75
 Fg 8 l rt f th w ll f f th y t sh w h
 ph gcyt ll X100

Fg 9 P t f th ll f y t sh g l dal
 Hlung X80
 Fg Ph t ms g ph f ypt f th y t
 Th lls d first ly l mn b tth ltl d nc
 f t m d l pm t X60
 Fg l hot m gr ph f pot f th ll of
 y t h ung p th l m l ed gl d These ho
 by rial ect t be t m l y l ted d t us
 th ryp t th ll f th y t X360

doubtless related to the hemorrhage occurring at menstruation into the corpus luteum which is dependent on certain little understood hormones. No doubt factors similar to those present in the case of hemorrhage occurring

into luteal bodies in the abdominal ovary were active in this case.

The reason for the development of the epithelium can more readily be appreciated. Non epithelial areas show evidences in the

toxic effect. Certain patients who showed such vasomotor symptoms, showed them again after the injection of sodium chloride and dextrose, which we know are non-toxic. Moreover, these vasomotor symptoms occurred less frequently with the passage of time after an atmosphere of confidence grew up in the clinic.¹

On the other hand occasional mild toxic signs after quinine urethane have occurred. The worst case was in a patient who, after an injection of quinine urethane, developed erythema over a considerable surface of the body lasting several days. This has occurred twice.

The use of bichloride of mercury solution for the injection treatment of varicose veins, by an outside physician not connected with the clinic, resulted in a death with typical bichloride of mercury poisoning.

There are two methods whereby the toxicity of different solutions may be measured and compared. In one method the minimal lethal dose of the various solutions is used. When the lethal dose has been determined the margin of safety is compared. In the other method a dosage which bears a constant ratio to the therapeutic doses is used. Then a comparison is made of the postmortem changes in the liver and kidneys of animals, killed a certain number of hours after injection. The comparison of the minimal lethal doses is necessary because some solutions, notably the cocaine derivatives, may kill and yet show no changes on postmortem examination. The comparison of the pathological changes in the viscera of the animals after definite doses is, however, more accurate. Both methods were used in our studies.

We were unable to find in the literature, determination of the minimal lethal doses of quinine hydrochloride urethane, lithium salicylate with tutocaine, sodium gluconate, sodium morrhuate, and sodium jecorolate. Quinine hydrochloride urethane acts very differently from quinine alone. Although urethane was added originally to increase the solubility of the quinine hydrochloride, the changes in

the physiological action of the quinine which it causes are profound. It forces the quinine for the most part out of the blood plasma into the corpuscles where it is fixed for 96 hours. At the same time it hastens the elimination of quinine through the kidneys (Matter).

Table I shows the results of our experiments to determine the minimal lethal doses on certain of these solutions injected intravenously into the marginal ear of young rabbits, unless otherwise indicated, approximating 2 kilograms in weight, in undivided doses. We have appended for comparison an estimate of the minimal lethal dose for the same animal of bichloride of mercury, sodium salicylate, met-

TABLE I—DETERMINATION OF DOSES LETHAL FOR YOUNG TWO KILOGRAM RABBITS WHEN INJECTED INTO THE MARGINAL VEIN OF EAR

Solution	Dose c cm	Number of animals	Results
Lithium salicylate 30 per cent with tutocaine 24 per cent	-	7	- died instantly
Sodium salicylate 30 per cent	4 6	3 (2 kilograms)	All lived Died instantly
Quinine HCl urethane not heated	0.5 0.7 1 1 (3 kilo rabbit) in two doses—one minute apart	4 3 2 1	No toxic signs All died Died in convulsions Lived after toxic symptoms head nystagmus and leg abduction
Quinine HCl urethane after heating on water bath 1 1/2 hour	0.5	3	Two showed marked toxic signs head nystagmus and leg abduction
Sodium gluconate 40 per cent		4	All lived 48 hr or more
Sodium jecorolate 5 per cent	2	6	All lived 75 hrs or more
Metapben 1:500	4	4	One died 1 wk later Others killed in 48 hrs showed marked kidney injury

RESULTS FROM OTHER SOLUTIONS ESTIMATED FROM THE FINDINGS OF OTHERS

Mercury bichloride 1 per cent	0.5 c cm	Lethal (Barbour-Menten)
Metapben 1:500	4 to 5 c cm	Lethal (Burkhaug)
Sodium salicylate 30 per cent	5, to 6.0 c cm more than 7 c cm in divided doses	Lethal (Blancher)
Quinine hydrochloride	0.5 c cm	Lethal (Charteris) Lethal (Solis-Cohen)

¹Since clinical assistants and nurses have been told the truth—that embolism while possible never has occurred until several days after injection—the atmosphere of confidence has increased and has had its effect on patients.

VARICOSE VEIN SOLUTIONS

RESEARCHES IN TOXICITY SLOUGH PRODUCING PROPERTIES AND BACTERICIDAL ACTION
AS RELATED TO PHLEBITIS AND EMBOLISM

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F. M. D. Actin. F. S. ery and Surg. al F. thology fth Los An tes G. al Hus. al

WHAT is the best solution for the injection treatment of varicose veins? Practitioners in all countries are asking this question unceasingly. They demand not the varying opinions expressed in the literature but facts determined by laboratory methods on which they may base their own conclusions. The writers have formulated exact standards of measurement so that the essential properties of solutions may be measured and compared over a common denominator. These essential properties are (1) toxicity (2) slough producing properties and (3) bactericidal powers as related to phlebitis and embolism. A fourth property that of efficiency in producing firm thrombosis and permanent obliteration is essential but beyond the scope of our present labors.

We have measured these properties in the more important of the classic solutions and also in the more recent ones proposed as improvements. Both groups may be briefly mentioned with reasons for their study.

The classic solutions have been criticized on various grounds. It has been claimed that bichloride of mercury is toxic that sodium salicylate is too painful and causes too many sloughs that quinine urethane is toxic painful and slough producing that invertose is inefficient and that sodium chloride is painful slough producing and inefficient. These criticisms have not always been based on rigid experimental investigation and the extent of the disadvantages needs to be measured.

The more recent solutions claimed as improvements are a weakened mixture containing sodium chloride 15 per cent and dextrose 25 per cent lithium salicylate 30 per cent with tutocaine 34 per cent sodium morrhuate 5 per cent to 10 per cent metaphen 1/5 per cent and sodium gluconate 30 per cent

to 40 per cent. The weakened solution of sodium chloride and dextrose has become increasingly popular in Germany and America receiving strong support in this country from McPheeter, de Takats and Kern. Sodium morrhuate a sodium soap of the fatty acid in cod liver oil first used by L. Rogers (20) in the treatment of leprosy and applied to varicose vein treatment by I. B. Kettel (15). Throughout Great Britain during the past year the growth in its use has been remarkable with strong sponsorship given by Noel Scott, A. Dickson Wright, J. H. T. Davies and A. C. Drynan. Hines and Kettel, D. Levi, T. H. T. Barber and L. Rogers (18). In America it has been used by Dixon of Rochester, Minnesota. Sodium jecorolate is the trade name for a preparation originally claimed by the manufacturers to be sodium morrhuate made from cod liver oil but now put out under the same trade name with the claim that it is a soap from the oil of the puffer fish. Lithium salicylate with tutocaine has been used in a large series of cases by Noel Scott and P. M. Deville of London. It does not cause the painful cramp associated with sodium salicylate but when kept more than 10 days turns brown and is said to be unfit for use longer. Metaphen has been used by Schussler in San Francisco and R. Gazol in Paris. Sodium gluconate is a salt of gluconic acid a derivative of glucose synthesized by Keenan and Weissberg.

TOXICITY

On various grounds we were impelled to compare the toxicity of different solutions in concentrations comparable to doses used for varicose vein injections. Clinical experience raises doubt as to whether vasomotor symptoms following the use of sodium salicylate or quinine urethane were consistently due to



Sodium salicylate, 30 per cent



Lithium salicylate, 30 per cent



Quinine urethane



Sodium chloride, 15 per cent, with dextrose 25 per cent



Metaphen, 1:250



Invertose, 50 per cent.

Fig 2 Sloughs on sixteenth day following injection by various solutions In lower left picture circle is ink mark around healed scar

body weight to ten times a therapeutic dose for a 70 kilogram man with varicose veins. Forty-eight hours later the animals were killed and gross and microscopic examination made of the liver and kidneys. We were satisfied that 48 hours was a sufficiently long time to wait because Menten had shown that even in a poison with as slow a clinical action as mercury bichloride, any toxic changes in the kidneys are to be found within 5 minutes after injection.

The results are shown in Table II. To our surprise, no important pathological changes in

the liver and kidneys could be demonstrated even after ten times a proportionate therapeutic dosage.

We tried using twenty times the proportionate therapeutic dose for a man with varicose veins. This dosage brought changes in the liver and kidneys, but as this dosage approximated the minimal lethal doses described in Table II the results are not considered sufficiently significant for description. The results of these experiments do not exclude the need for caution in the use of mercury derivatives.



Fig. 1. Stes f bc ta inj t th d t mut
t f p g h by d m k

aphen and quinine alone on the basis of the work of others.¹

From Table I we may calculate that for rabbits the margin of safety expressed in terms of the ratio of the therapeutic dose is

		Class I dose m	Le b t dose m	R
Sod m	l y l t 3 p	4/35	4	35
L th m	aal cy t 3 p			
t	th t toc	4/35		7
Q	th hyd ochl rid	7/35	75	5
Vi taph	500		4	
Vi t	ry b hl d p	/35	8	8
		4/35	8	7

It will be seen that the margin of safety for lithium salicylate with tutocaine is less than for sodium salicylate and it should therefore be used clinically in smaller doses.

Although histological examination of the liver and kidneys showed no differences when quinine hydrochloride urethane solution was heated on a water bath or unheated the fact that four animals receiving 0.5 cubic centimeter of the unboiled solution showed no

as Hanahlik has demon- strated their unconsciousness in very large doses.

toxic symptoms whereas 2 out of 3 animals receiving the same dosage of the boiled solution showed marked toxic signs suggests that this solution should not be sterilized by boiling. We shall show below that it is self sterilizing to staphylococcus aureus. This solution should be prepared aseptically, left standing 72 hours and then cultured.

In a further series of experiments we made microscopic studies of the liver and kidneys of rabbits after intravenous administration of the solutions mentioned. We first used doses proportionately equal after making due allowances for differences in body weight to the clinical doses for varicose veins as follows:

Vi ry b chl d p	t	m
Sod um salicyl t 4 p	t	/35
L th m sal cy t 3 p	t th t toc	3/35
Q	nun hyd ochl d	4/35
Sod m hl d 5 p	t th dext se 5 p	/35
t		6/35
Sod m	rr t t 5 p	t
Sod m gl	t 4 p	t
Vi t ph	500	4/35
Phy l g	f d m hl d	6/35

None of these clinical doses adjusted to the weight of the animal caused changes in the liver and kidneys discoverable by microscopic examination when the animals were killed and examined 48 hours later. In this work some solutions previously tested by Hanahlik, Birkhaug and Kolmer Lucke were included because results with individual technique vary so that a comparison can be best made by a constant technique.

We continued our microscopic study of the liver and kidneys of rabbits following the use of massive doses. We used massive doses because even though the susceptibility to drugs varies in different species of animals and in different individuals, immense doses ought to overcome the difficulty of variable sensitivity in different species and different individuals. We wished to be aware also of danger from the cumulative effect of many doses given in repeated injections. Moreover large doses in their effect on the histological picture would magnify and bring into bold relief differences in toxic action by various solutions. Accordingly in young rabbits approximately 2 kilograms doses were used equivalent per



Sodium salicylate, 30 per cent



Lithium salicylate, 30 per cent



Quinine urethane



Sodium chloride, 15 per cent, with dextrose 25 per cent



Metaphen, 1:250



Invertose, 50 per cent

Fig 2 Sloughs on sixteenth day following injection by various solutions In lower left picture circle is ink mark around healed scar

body weight to ten times a therapeutic dose for a 70 kilogram man with varicose veins. Forty-eight hours later the animals were killed and gross and microscopic examination made of the liver and kidneys. We were satisfied that 48 hours was a sufficiently long time to wait because Menten had shown that even in a poison with as slow a clinical action as mercury bichloride, any toxic changes in the kidneys are to be found within 5 minutes after injection.

The results are shown in Table II. To our surprise, no important pathological changes in

the liver and kidneys could be demonstrated, even after ten times a proportionate therapeutic dosage.

We tried using twenty times the proportionate therapeutic dose for a man with varicose veins. This dosage brought changes in the liver and kidneys, but as this dosage approximated the minimal lethal doses described in Table II the results are not considered sufficiently significant for description. The results of these experiments do not exclude the need for caution in the use of mercury derivatives.

TABLE II—MICROSCOPIC STUDY OF THE LIVER AND KIDNEYS OF TWO KILOGRAM RABBITS AFTER INTRAVENOUS INJECTION OF 10 TIMES THE PROPORTIONATE THERAPEUTIC DOSE FOR VARICOSE VEIN PATIENTS

S?	Ti pe dwe f m	Dos for bb	Number m l d	Results l h in d
L. h. m. salicyl pe		X—X m m		1 y 1 h d l l l l
Sod m sal i pe		X—X m m		1 y 1 h l l l l
Sod m H ₂ O pe		X—X m m		1 y 1 h l l l l
Qu HCl b		X—X m m		1 y 1 h l l l l
am he ed f he h th		X—X m m		1 y 1 h l l l l
f la h oos		X—X m m		1 y 1 h l l l l
Sod m l pe		X—X m m		1 y 1 h l l l l
Co Cl h l p l		X—X m m		1 y 1 h l l l l

A death from 1 cubic centimeter of 1 per cent bichloride of mercury solution injected into varicose veins has been reported by Hammar and a death from 4 cubic centimeters of 1 per cent mercury bismuthide following earlier injection of larger doses by R. C. Mundt. The facts of the third death from mercury poisoning following injection of varicose veins occurring in Los Angeles as provided by the family and the physician are these:

1 h saw f 33 years ld had h m j i d th
th < l t h h pro d ff t t b g bl t
t h th t t phy h mad j t
f m ey b hl d ll phy t t th t h sed
s l ce tim s f sol t h ch h bel ed
h d edith f pe t d jected ll t
b t t t t t m t aft ject
th f it ll t l 4 h ra l wh sh f d
th if f h h m m t g C npl t n f fl d
d d d y t t h t ed with g lized red m

SLOUGH PRODUCING PROPERTIES

Sloughs following the extravascular escape of solutions injected for varicose veins in the

clinic of the Los Angeles General Hospital are rare although the use of sodium salicylate and quinine is allowed both of which may cause severe sloughs when injected out of the vein.

However with the occasional worker the slough problem is serious. In the past 6 months we have received personal communications reporting 10 sloughs from quinine urethane 3 from sodium salicylate and 5 sloughs from sodium chloride with dextrose. One of these sodium chloride with dextrose sloughs has remained unhealed for 8 months and measures 4 by 2 centimeters at the present time. It followed the injection of a large possibly an unreasonable amount of solution 20 cubic centimeters. Two fatalities have been reported from sepsis following infected sloughs. The slough problem is sufficient to justify serious research.

The comparative slough producing properties of different solutions cannot be estimated without a standard of measurement. In seeking a standard of measurement we found the experiment of Howard Kern suggestive but not convincing. He injected a solution containing sodium chloride 15 per cent and dextrose 25 per cent intentionally outside of any vein subcutaneously in the leg of a dog. No slough resulted and he therefore supposed that the solution was tough proof. This experiment is not reported as having been controlled with known slough producing solutions. For example we have injected in the leg of a rabbit over the biceps femoris 1 cubic centimeter of sodium salicylate 40 per cent a solution which is known to be violently caustic and slough producing. No slough formed. We have twice injected 2 cubic centimeters of sodium salicylate 40 per cent subcutaneously in the lateral body wall of rabbits without being able to obtain a slough.

We found a test for slough producing properties which is delicately sensitive and a basis for measured comparison. This is the use of the ear lobe of a young rabbit. Here the skin surfaces on both sides of the ear lobe are so close together that there is no room for wide diffusion of solution in loose areolar tissue.

On the ear lobe of a rabbit, the skin surfaces on both sides of the ear lobe are so close together that there is no room for wide diffusion of solution in loose areolar tissue.

This part of the ear is not dirtied in the pen and is not liable to infection. Injections were made a little medial to the central artery of the ear lobe, where there is no cartilage, in almost the exact center of the ear. A measurement of 1 plus for the solution was used when the slough produced from injection of 0.25 cubic centimeter of solution at this point approximated in diameter 0.5 centimeter, 2 plus when it was 1 centimeter, 3 plus when 1.5 centimeters, and 4 plus when 2 centimeters in diameter. A total of 92 injections were made, including 54 injections with sclerosing solutions and 42 controls. Only one injection of a sclerosing solution was made in any one ear lobe, but a control of 0.25 cubic centimeter of physiological salt solution was made in every case in the same ear lobe at least 4 centimeters away and nearer to the tip of the ear. The results are shown in Table III. Observations were taken at the end of 6 and 16 days.

Table III shows that the comparative slough producing properties of the solutions are as follows: sodium salicylate, 4 plus; lithium salicylate, 4 plus; quinine urethane, 4 plus; sodium chloride, 2 plus with rapid healing; dextrose and sodium chloride, 2 plus with rapid healing; invertose, 1 plus with very rapid healing; sodium gluconate, 1 plus with very rapid healing; metapphen with very rapid healing, and "sodium jecorrolate" variable.

When it is considered that quinine urethane is used clinically in less than one-fourth the dosage of other solutions, it will be realized that its slough producing properties per clinical dose are comparatively better than is indicated above. In four human subjects mentioned below, who received 0.5 cubic centimeter of quinine urethane subcutaneously, none had any slough. When quinine urethane is used, sloughing is more likely to occur when leakage along the tract of the puncture is not prevented by prolonged pressure by the finger.

Although sodium salicylate admittedly gives severe sloughs, it was defended by the late Sicard on the ground that it is safer from the standpoint of sloughs, because it gives immediate warning by pain as soon as any of it escapes extravascularly. He used to say that any anæsthetic added to a solution to

TABLE III—DETERMINATION OF THE COMPARATIVE SLOUGH PRODUCING PROPERTIES OF VARIOUS SOLUTIONS BY THE INJECTION OF 0.25 CUBIC CENTIMETER SUBCUTANEOUSLY IN THE EAR LOBE OF RABBITS

Solutions used	Number of injections	6 days	16 days
Sodium salicylate 30 per cent	3/18/31 4		
Lithium salicylate 30 per cent with tincture of eucalypti 1 per cent	4		
Quinine 13 per cent Urethane 7 per cent	13		
Sodium chloride 0 per cent	6		
Invertose	4		
Sodium morrhuate 3 per cent	7		
Sodium jecorrolate 5 per cent	6		
Dextrose 25 per cent and sodium chloride 25 per cent with phenyl carbinol 15 per cent	4		
Metapphen 1/3 per cent	4		
Sodium gluconate 40 per cent	4		
Physiological saline as control	44	none	none

prevent the cramp following injection, would increase also the danger of the development of sloughs because the instant warning of pain when the solution was injected out of the vein would be lost.

Accordingly experiment 4 was performed on

TABLE IV—DETERMINATION OF COMPARATIVE WARNING BY PAIN GIVEN BY DIFFERENT SOLUTIONS INJECTED SUBCUTANEOUSLY IN LEGS OF FOUR HUMAN SUBJECTS

	I	II	III	IV
Sodium salicylate per cent	+++	+++	+++	+++
Lithium salicylate with 1% local anesthetic	+++	+++	+++	+++
Dextrose per cent	+	++	++	+++
Sodium bicarbonate per cent with 1% local anesthetic	+	+	+	+++
Dextrose 60 per cent		+	+++	+++
Sodium per cent	+	+++	+++	+++
Quinine urethane per cent	+	+++	+++	+

4 human subjects healthy males between the ages of 25 and 40 years. Into the legs of each of the subjects seven solutions were injected subcutaneously with a gauge 25 needle at locations as shown in the photograph some what posterior to the course of the saphenous nerve and great saphenous vein between the knee and ankle. The subjects were unaware as to what solutions were used and the solutions were rotated around at different sites to allow for variation in sensitivity at different sites and to allow for increased pain sensitivity or pain nerve fatigue following previous injection. In Table IV is shown the dosage in minims which the patients could stand without an outcry and the degree of pain as reported by each subject. One plus was used to indicate slight but perceptible pain 2 plus for moderately severe pain 3 plus for marked pain and 4 plus for violently severe pain. No attention was paid to pain following the injection for only the response elicited at the instant of injection can give warning in time to cause the operator who injects varicose veins to cease injection.

The results of experiment 4 show agreement as reported by the different subjects. It will be seen that while sodium salicylate gives emphatic warning the instant even 1 drop is injected extravascularly other solutions except quinine urethane and possibly dextrose give a warning sufficiently decisive. In three of the four subjects not the slightest warning

of its extravascular escape was given by quinine urethane even when 0.5 cubic centimeter a fair sized dose was injected extravascularly. In the use of quinine the only indication that the needle is staying in the vein is repeated aspiration of freely flowing blood in between pushes on the plunger. One cannot as in other solutions be protected by pain warning from the patient.

BACTERICIDAL POWERS AS RELATED TO PHLEBITIS AND EMBOLISM

The writers are not opposed to the injection treatment of varicose veins their experience covering ten thousand injections without a fatality leads them to consider that this method may be one of the safest of surgical procedures. At the same time facts must be faced. In the past 4 years there has been an increase generally of deaths from sepsis and embolism due to the injection treatment of varicose veins. In 15 years previous to January 1, 1927 17th modern solutions there had been reported 2 deaths from sepsis and embolism in 45,000 patients. In the past 4 years there have been 15 deaths from sepsis and embolism reported due to injection treatment not counting 1 other fatality following injection in which there was doubt as to whether vein injection or other factors caused the pulmonary symptoms. The sources of this information are omitted for lack of space but will be provided on application.

It is improbable that this increase in deaths from sepsis and embolism from 2 deaths in 15 years to 15 deaths in 4 years is to be explained entirely on the basis of the increase in use of the injection method. The great clinics which had reported their thousand of cases in the past are not reporting increased mortalities. Where new case series of importance such as that of Noel Scott with ten thousand cases and A. A. Schmeer with three thousand cases have appeared there were no mortalities. The mortalities have come largely from inexperienced workers.

Of the 17 fatalities from sepsis or embolism there are 11 in which the solution is stated or

if the material is not perfect if the result is the blood may be outside the vein.

could have had a bearing on the problem. Of these 11, 4 followed the use of sugar solutions, 3 followed the use of sodium chloride, 1 followed the use of a mixture of sodium chloride and dextrose, 2 followed sodium salicylate, 1 followed Pregl's iodine solution, and none followed quinine urethane.

There may be several causative factors in this mortality. Linser, at the surgical congress at Basle in 1931, laid blame at the door of the sugar solutions, because these are so mild in their effect on the vein walls that a firmly enrooted thrombus is not obtained and emboli are easily detached. Lack of wisdom in the quantity of solution used and in the choice of patients suitable for injection has also been discussed by Kilbourne.¹

We, however, have been led to the study of a different factor. It will be noted that sodium chloride solution has nearly the same score of fatalities as sugar solutions. Most of the deaths in which the solutions were stated, have occurred with sugars or sodium chloride, either alone or in combination. None has been reported with quinine urethane.

Recently, in a study of concentrated solutions of dextrose or of sodium chloride provided by apothecaries and labelled as sterile solutions for varicose vein injections, Herzfeld and Schultz found that one-half of twelve specimens contained viable staphylococci or sarcinae.² Heiler³ has found viable staphylococci in half of the solutions of concentrated sodium chloride and sugar. Eiselsberg and Okalska³ are quoted as finding viable typhoid bacilli after 48 hours' immersion in concentrated sugar and salt solutions. When we consider that our present popular solution of a mixture of the two weakens the concentration of each with a consequent weakening of osmotic pressure on bacteria which may come into contact with the solution, and that Heiler has shown that the addition of nutritive material (compare the 25 per cent dex-

trose added) increases the resistance of bacteria to osmotic pressure, it is evident that such solutions are not in the least self-sterilizing and are liable to contamination when used in that type of wound most dangerous from the standpoint of infection, the punctate wound. The presence of bacteria in the deeper skin layers in spite of "skin disinfection" has been demonstrated many times. When we consider the high percentage of laparotomy wounds with imperfect hæmorrhage that develop stitch hole infections (sometimes estimated at 10 per cent), it is no wonder that in thousands of punctate wounds into veins in which the circulation is poor and the blood is stagnant or thrombosed, infection sometimes develops.

In a large percentage of embolic accidents, infection has been reported as intervening between injection and embolism. Bacterial and leucocytic enzymes make short work of the anchorage of a thrombus.

We decided to ascertain whether other solutions, which showed an absence of fatalities, had self-sterilizing and bactericidal powers. As the staphylococcus is the most common germ in the skin layers, our tests were made not with the phenol coefficient, but against staphylococcus aureus taken from a carbuncle and cultured for 24 hours in broth. In experiments 1 to 7 of Table V, one part of the broth culture of staphylococcus aureus was added to nine parts of the solution to be tested in the dilutions indicated. The mixture was incubated for 5 minutes and transplants were then made on agar slants and incubated for 24 hours, 48 hours, and 72 hours. In experiments 8 to 11 one part broth culture was added to 50 parts of solution to be tested. The 1:2 dilution was incubated 5 minutes and the 1:5 dilution for 10 minutes on a water bath at 37 degrees C, after which one loopful was transferred to 10 cubic centimeters of sterile broth and incubated at 37 degrees C for 72 hours. Those transplants which remained sterile during 72 hours' incubation were re-inoculated with a loopful of a 24 hour broth culture of staphylococcus aureus. Growth developed in 24 hours' incubation. This was done to show that the test was for bactericidal action and to ensure that no bacteriostatic

¹ Kuhn Franz noted a fibrinolytic action by dextrose in the peritoneal cavity. Buchbinder also noted the fibrinolytic action of dextrose and its tendency on the peritoneum to act unfavorably on infection. Against the likelihood of such action by dextrose in veins is the fact that the solution seldom remains long in the veins. In this connection it is well to recall the roentgenological evidence provided by G. Magnus Sicard, Forester and A. A. Schmir showing that in the recumbent position the blood flow in varicose veins is not, as is so frequently stated, toward the feet, but toward the heart and lungs.

² Solutions in ampullæ examined were found well sterilized.

³ Quoted by Herzfeld and Schultz.

TABLE 1.—DETERMINATION OF THE BACTERICIDAL POWERS OF VARIOUS SOLUTIONS FOR VARICOSE VEIN INJECTION

Sol no	G in th hr	G in 48 hr	Growth in 7 hrs.
1 per lithium salicy- late 5 dil dil to	+	+	+
1 per ent) thium salicy d tocan d l dil to	+	+	+
5 S per en sodium ec late dil to	+	+	+
per ent sol to so- dium gluco te dil to	+	+	+
5 per an N Cl in h per en gl cose (qual ar) dil to	+	+	+
6 pe N Cl dil to	+	+	+
la tiodi n sal dil to	+	+	+
Sodium morbuate or talc pe sol to in teril d till d () p reserva dded dil to s per cent dil	+	+	
5 Sodium morbuas per ent, th has l s per en () d l tion s dil	+		
Q ual h d ochl de than p en and ur 666 per en () dil so s dil			

Bush Drug H uses, Ltd Same as so made th 5 per
re ded in amp ll by Associated f man Labor Union, L d
and by S arl ad d
†B b Drug H ves L d ampulle
‡Parke, D via & Co

material in the solutions was transferred with the loop to the broth transplants. Control cultures on sterile distilled water used for dilutions showed no growth in 72 hours.

The results show that the sugar derivatives and sodium chloride are not self sterilizing to staphylococcus aureus even in concentrations higher than is commonly used in their mixture in varicose vein injection. Sodium salicylate and lithium salicylate are self sterilizing in strong solutions only. Sodium morrhuate is not self sterilizing. Quinine urethane solution is bactericidal even in a dilution of 1:5.

The fact that sugar and salt solutions are so easily contaminated with bacteria and have

been occasionally associated with infection and embolic fatalities bespeaks the need for unusual care in aseptic technique when these solutions are used.

SUMMARY

Mercury bichloride and biniodide in the injection treatment of varicose veins have been fatally toxic in three cases.

Metaphen is less toxic and is not likely to cause a slough. Experiments on rabbits did not indicate serious danger from toxicity in other solutions tested.

Sugar derivatives and sodium chloride are non toxic and relatively painless. Their use has been associated with an incidence of deaths from infection and embolism not found with quinine urethane. Unlike quinine urethane they are not self sterilizing, or bactericidal. Since they are easily contaminated they should be handled with extraordinary care in technique to prevent infection. The sloughs which they make when injected out of the vein are less serious than the salicylate and quinine sloughs.

Sodium salicylate is efficient as a sclerosing agent. It is bactericidal to staphylococcus aureus only in the strong solutions. It may cause a painful cramp after injection and the sloughs which it makes are more serious than those following dextrose and sodium chloride. Lithium salicylate avoids the pain of sodium salicylate but is slightly more toxic and is said not to keep well in solution.

Quinine urethane is highly efficient as a sclerosing agent and even when diluted is bactericidal to staphylococcus aureus. It has a perfect mortality record possibly due to its bactericidal action in preventing phlebitis and embolism. It may be slightly toxic to occasional patients and when injected out of the vein does not give the warning of pain given by the other solutions. It causes no pain at time of injection and if the leg is kept bandaged the occasional pain the next day is usually prevented. Because of its perfect mortality record we regard it in expert hands the solution of choice—except in small superficial thin walled veins provided of course it is used by those sufficiently experienced not to allow extravascular escape.

Sodium morrhuate is not a toxic solution, and if injected out of the vein the sloughs which it makes are not so serious as the salicylate and quinine sloughs. It is not bactericidal or self-sterilizing.

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CHANGES WHICH THE ARTICULAR CARTILAGE OF THE HIP JOINT MAY UNDERGO¹

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THE phenomenon of regeneration in articular cartilage according to the general idea is a slow process and it is even held by many that it does not occur at all in the central portion where it is free of perichondrial covering. This deduction has been based for the most part on observations upon the reparative changes which incisions or defects made in hyaline cartilage of experimental animals undergo. In a previous paper on *Changes in the Femoral Head Following Complete Intracapsular Fracture of the Neck. Their Bearing on Non union and Treatment* the writer included a brief description of cartilage proliferation which was noted to be invariably associated with an invasion of the articular cartilage by the underlying marrow. In the present article a more extensive study of this subject with a more detailed description of the microscopic changes in the articular surfaces of the joint will be given.

In order to understand clearly the accompanying observation on the various changes that take place in the articular cartilage certain fundamental points which are generally acknowledged as to the structure, nutrition and method of repair of cartilage may be briefly reviewed.

STRUCTURE OF THE ARTICULAR CARTILAGE

For a long time in the past it has been the prevalent conception that the free surface of the cartilage is covered by an envelope of dense connective tissue the perichondrium. Hunter stated that the perichondrium of the smooth articular cartilage is fine and firmly attached to the surface and is a continuation of that fine smooth membrane that lines the capsule of the ligament folded over the end of the bone from the insertion of the ligament. Henle also described the presence of a delicate layer of cells (perichondrial) on the free surface of the articular cartilage. Leidy however and later on Todd and Bowman held

that there is no trace of synovial membrane or perichondrium on the free surface of the articular cartilage or on that part of the articular cartilage exposed to pressure during movements of the joint. After confirming this latter view A. G. Timbrell Fisher and avowed to show that the central and lateral portions of the articular cartilage have a fundamental difference as to structure and nutrition and subsequently as to the method of repair. The actual free surface of the central part of the articular cartilage has no layer of cells but that it is formed of a clear matrix with a sharp curvilinear margin. In the deeper strata of the matrix are seen columns of cartilage cells which run perpendicularly to the narrow sub-articular layer of bone upon which they lie as these become more superficial the columns contain fewer cells and are distributed in an irregular manner and the uppermost groups lie flattened conformably with the surface. Unlike Ogston's claims these latter cells show no sign of degeneracy and have every appearance of being normal healthy cells. The free surface of the lateral portion of the articular cartilage is covered by a layer of cells with thin elongated nuclei (perichondrium). This consists of an outer loosely arranged fibrous layer which according to Schaefer contains the blood supply a median compact layer with plate like nuclei and an inner layer of elongated and at times oval vesicular nuclei (the chondroblastic cells). This part of the cartilage is similar in appearance to costal cartilage. The synovial membrane gives to this part a delicate investment in which well marked capillaries may be traced. A deposit of calcium salts is generally seen in the deeper layers of both parts of the articular cartilage where it lies in contact with the bone—this is oftentimes called the zone of calcified cartilage.

Nutrition of the articular cartilage. Various theories and observations have been reported as to the probable sources of nutrition of this tissue. William Hunter as far back as 1742

¹ This work was done in the Children's Hospital School and conducted in cooperation with the Junior Club of the Junior Medical Association.

as a result of a series of injection experiments of the arteries of the limbs, described his "circulus vasculosus articulari" formed by a fine network of vessels which lie near the articular edge and underneath the synovial membrane. It gives delicate off-shoots to the lateral border of the articular cartilage. The fluid from these vessels is supposed to reach the cartilage cells by imbibition. Some tried to demonstrate the existence of fine and minute interfascicular canals within the cartilage. No connection, however, of these canals with the general lymphatic circulation has been demonstrated. Other observers have described lymph channels in the hyaline matrix but the existence of these is very doubtful. Toynbee, on the other hand, asserted that the articular cartilage derived its nourishment from plasma exuded from the capillary loops lying in the cancellous spaces or plates abutting on the calcified layer. Leidy stated that after the cartilage has been fully formed, it is supplied by fluid that osmotes from the vessels beneath its attached surface, and from the circulus vasculosus at its lateral border, and especially by the synovia upon its free surface. Timbrell Fisher seemed to believe that the deeper layer of the articular cartilage is nourished by the blood vessels of the cancellous spaces, that the central articular area derives its nutriment from the synovial fluid, and that the part of the articular cartilage near its lateral circumference is supplied by the "circulus vasculosus articulari." Strange-ways argues that the synovial fluid is the main source of nutrition for the articular cartilage and that loose cartilaginous bodies not only survive in the joint cavities but also may increase in size while free in the joint. From this experience with loose bodies in the joints and from the frequent observation of persistence of the articular cartilage notwithstanding the total necrosis of the attached bone, it is the consensus of opinion among the Germans that the synovial fluid is the only source of nourishment for the articular cartilage.

A review of the histogenesis of hyaline cartilage covered with perichondrium, of the survival of its cells, and the processes which it undergoes following free transplantation, re-

veals the fact that the perichondrium is mainly responsible for its final regenerative changes, and that in the transformative processes the presence of normal nutrition of this avascular tissue does not take an active part. It is not within the scope of this paper to deal with the regenerative changes that take place in hyaline cartilage covered with perichondrium. In this connection, however, there are certain fundamental points regarding the method of repair that must be reviewed, as it is beyond doubt not only from analogy, but from development, structure, and comparative anatomy that the similarity to the part of the articular cartilage near its lateral circumference is discovered. As this paper necessitates brevity, an extensive and detailed review of the literature on this subject is therefore precluded and only a generalized summary of the prevailing conceptions will be given.

The experiments on cartilage grafts and investigations with regard to the healing processes in cartilage defects as a whole seem to warrant the following conclusions which are limited to hyaline cartilage covered with perichondrium. (1) The taking and survival of cartilage grafts is in direct proportion to the condition of preservation of the perichondrium, when the perichondrium is very carefully preserved the graft takes and survives for a long time without showing changes in histological structure. This property is more marked the less differentiated the cartilage is and the more closely related it is biologically to the tissue into which it is grafted. (2) Fragments of cartilage deprived of perichondrium are quickly surrounded by a connective tissue capsule and absorbed. (3) Grafts in which the perichondrium and superficial layers of the cartilage have been injured undergo slow absorption. The cartilage tissue which is absorbed is replaced by a proliferation of young cartilage which begins at the point where the perichondrium was injured.

Although the literature on regeneration of cartilage is replete with reports of experimental studies made on hyaline cartilage covered with perichondrium yet it is surprising that similar investigation on the central part of the articular cartilage which is known to be wanting of perichondrial covering, ap-

pears to have received scant attention. In 1853 Kolliker stated that cartilage possessed no power of regeneration and that wounds of cartilage do not heal by a proliferation of the cartilage substance. Timbrell Fisher in 1923 noted absence of repair $7\frac{1}{2}$ months following an incision made in the trochlear surface of the femur of a rabbit and through the whole thickness of the articular cartilage. From this he concluded in confirmation of Redfern's experimental findings that incisions in the central part of articular cartilage heal if at all with great sluggishness and that there is an absence of cartilaginous repair unless the underlying cancellous spaces have been exposed. In this area the formation of cartilage is slight and occurs through the agency of the connective tissue cells of the exposed cancellous spaces. Incisions in the lateral portion however exhibit an active repair and there is a new formation of articular cartilage in which both cartilage itself and perichondrium participate. A year later Ito removed a piece of articular cartilage together with a portion of underlying bone from the condylar surface of the femur of rabbits and observed a partial cartilaginous repair of the defect. He stated

In some specimens it appears that the reparative tissue has come from the underlying cancellous tissue in others transitional cartilage like tissue seems to arise in connection with the edges of synovial membrane if the injury to the articular cartilage has approached them. Haebler cut thin layers of cartilage out of the intercondyloid fossa of the femur of dogs care being taken not to open the subchondral marrow. At another point in the intercondyloid fossa a cartilage bone disc 5 millimeters in diameter was punched out and removed. The intercondyloid fossa was chosen because it is far removed from perichondrium and there are not great functional demands made on it. Twenty two dogs were operated upon and examined at intervals of from 5 to 320 days afterward. These experiments showed that the joint cartilage has little or no regenerative power. In cases in which there was undisturbed healing of wounds involving the joint cartilage alone there was no change in 304 days. If the subchondral bone was injured

the blood clot which filled the wound underwent connective tissue organization from the marrow and this connective tissue later became transformed into cartilage—a true metaplasia into hyaline cartilage. There was, however, no complete restoration to normal to the extent that the defect was completely filled with hyaline cartilage. In the subchondral region there was new formation of sufficient bone to form a basal layer which again closed the marrow spaces. The newly formed bone never reached however above the level of the normal cartilage and generally did not completely fill the defect. Shands performed experiments on the joints of dogs in an attempt to study the regenerative changes which superficial and deep defects created in the various regions of the articular cartilage undergo. The reactive processes of the cartilage to direct trauma were also noted. As a rule regeneration of cartilage was observed after a period of 4 weeks following the operation. He states. In these regenerative changes the following tissues have been observed to appear first fibrin second granulation tissue third connective tissue fourth cartilage cells in connective tissue (connective tissue cartilage) fifth fibrocartilage and sixth new hyaline cartilage. Regeneration of hyaline cartilage has been found in superficial defects not involving the subchondral bone. The greatest amount of regeneration however is seen in those deep defects which do involve the subchondral bone. Hyaline cartilage is observed to react occasionally to direct trauma with a proliferation of rests of new cartilage cells. The following deductions may be drawn as to the reparative processes in the central portion of the articular cartilage which shows no perichondrial covering: (1) No new formation of cartilage from proliferation of the cells of the articular cartilage occurs in this region. (2) Defects involving the cartilage alone may or may not undergo cartilaginous repair. (3) Defects however of the central part of the articular cartilage involving the underlying cancellous spaces may in part show a sluggish new formation of cartilage. The reparative tissue appears to come from the connective tissue cells of the exposed cancellous spaces through metaplasia.

Striking instances of what appeared to be an active proliferation of hyaline cartilage at the central part of the articular cartilage have recently been observed. The regenerated cartilage appeared to have come not only from the cells of the layer of vascular connective tissue (pannus) which has spread over the joint surface of the central part of the articular cartilage, but also from the old cartilage itself. Throughout the vicinity of the regenerated cartilage, there is always noted an invasion of the deeper layer of the articular cartilage by the subchondral blood vessels. This association is prominent and constant whether or not there was evidence of previous exposure of the underlying cancellous spaces with subsequent invasion and replacement by connective tissue.

CASE REPORTS

Case 1 shows that following complete intracapsular fracture of the neck of the femur, the head may remain alive. The articular cartilage may, however, undergo a degenerative change and its superior portion be invaded and replaced by the underlying subchondral marrow. With this degenerative process there occurs a marked proliferation of some of the surviving cells in the deeper layer and about the invaded region.

CASE 1. Male, 60 years of age, was operated upon for the removal of the femoral head following complete and unreduced intracapsular fracture of the neck which happened about 16 months ago. A roentgenogram taken of the hip on the day of operation showed a diffused decrease in the density of the femoral head. Macroscopic examination of the removed head revealed normal spherical contour. The articular cartilage was intact and appeared normal to the naked eye. There was no loss of substance except normally at the fovea. On microscopic examination the spongiosa showed changes in the marrow and bony trabeculae commonly seen in marked atrophy. The ligamentum teres was intact but gave no connective tissue extension (pannus) over the joint surface of the articular cartilage. The articular surface varied in thickness being thickest about the lateral circumference and thin over the superior or central portion about the region of the fovea. The entire extent and depth of the cartilage took rather poorly the hæmatoxylin stain. The cartilage cells in general were present and stained fairly well. In the superficial layer, however, one encounters here and there, empty cartilage lacunae and Weichselbaum's lacunae, and a disappearance of the cells. In some places, the lacunae

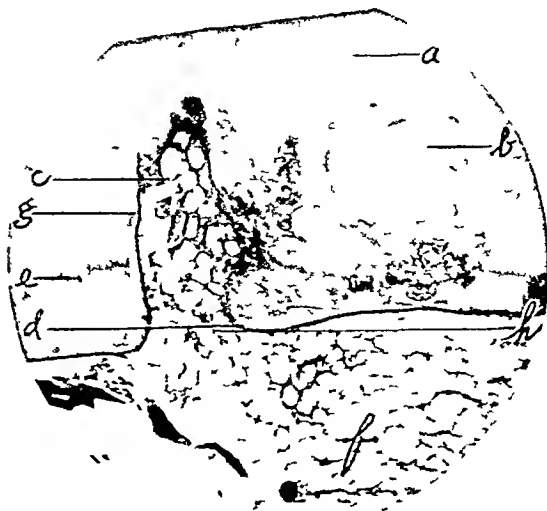


Fig. 1. A part of the superior portion of the articular cartilage. Note *a*, loss of cartilage cells, *b*, dilated Weichselbaum's lacuna invaded and filled by fibroblasts showing now and then transformation into cartilage cells, *c*, invasion of the articular cartilage by the subchondral marrow, *d*, subchondral bone, *e*, preparatory zone of calcification, *f*, subchondral marrow, *g*, newly formed bone partially lining the chondral marrow cavity, *h*, thin walled blood vessel $\times 30$.

appeared somewhat dilated and in others there was evidence of actual fusion of several empty lacunae. The presence of these enlarged and fused lacunae was especially evident at the deeper layer of the superior portion of the cartilage about the region of the fovea. The deeper layer showed an irregular arrangement of the cartilage cells which as a whole, were present and stained well. They appeared normal except at about the superior portion of the articular cartilage where the cells showed evidence of marked proliferation. Most of the lacunae in this region were quite enlarged and lay in a matrix of deeply staining ground substance. Each lacuna contained from 4 to 16 cells which were generally elongated and tended to assume a position perpendicular to the joint surface. This region of cartilage proliferation occupied the superior half of the calcified layer and extended to about the surface of the cartilage where, here and there, Weichselbaum's lacunae were encountered. It was found immediately adjacent to a defect in the articular cartilage which had been caused by the invasion and replacement of it from the underlying marrow. The narrow strip of subchondral bone at the osteochondral margin was intact and was normally attached along its whole extent to the preparatory zone of calcification. At the superior portion, it was surrounded by a very fatty marrow, and numerous multinucleated giant cells. Here, the overlying articular cartilage showed an invasion from the underlying marrow which had apparently broken its



Fig Ph t g ph f ect f m t d h i ph
f m al head f l l w mplet t pul f tur f
th eck N t h d l ma w ca t f m d by th
l th d g ted art cul ca t l g by th
d ly g bch nd l ma w b light ca h ch
re po d t th fully f m d t lar ca t l g by th
p l f t o f m f th cartil g l a b t th
ch d l marrow p es t ph p g

ay th ough the p epa at ry o e f alci at n
a d f m d a m w e v ty in the t ula rti
lage Th sch d al ma w spa e e t d n me
u m l n cle t d g n t l l s fat e l l s lymph d
c l l nd few th w l l ed bl od e s l \ r o
st p s f ew l f m d l a m l l b n e e cen t the
ma gn of the ty l t s t urac made up
of a th n s t p f th s p e r f i l l y f th ca t l g e
h h o t n e d n m e o s m p t y l a n e

In its microscopic features this case showed the typical findings in the central portion of the articular cartilage of a separated alive but atrophic femoral head following complete intracapsular fracture of the neck. It may be assumed that in this case the pathological process was initiated by a partial degeneration of the articular cartilage as evidenced by the presence of numerous empty cartilage lacunae. This was then followed by an invasion replacement and vascularization of the deeper portion of the central part of the cartilage from the underlying subchondral marrow formation of narrow strips of lamellar bone lining the chondral marrow spaces thus created and the formation of new hyaline cartilage from proliferation of some of the surviving cells of the articular cartilage about the chondral marrow cavity which might be interpreted as having been stimulated by the secondary vascularization of the articular cartilage. This assumption is supported by the usual finding of areas or areas of newly formed hyaline cartilage from the proliferation of surviving cells of the articular cartilage where such vascularization is present. As re-

gards the multinucleated giant cells they were encountered in great numbers where the chondral cavity was present and none else where. They were seen lying not only within the chondral space but also in the underlying subchondral region. It would seem probable in view of this observation that in this case the multinucleated giant cells were the active proximate agent in the invasion and absorption of the articular cartilage with or without help from the marrow blood vessels.

In cases in which the fracture and separation of the fragments has existed for a period of 4 years marked atrophic change in the femoral head may be noted. The articular cartilage may show marked degeneration with subsequent overgrowth of its joint surface by a layer of vascular connective tissue (pannus) proceeding from the ligamentum teres about its attachment at the fovea. Invasion and replacement of the articular cartilage by the subchondral marrow may also be seen. With it there is a secondary proliferation of the surviving cartilage cells in its immediate vicinity. Formation of islands of new hyaline cartilage may also take place from proliferation of certain cells of the deeper layer of the pannus. This may be illustrated by the following case:

Cas M l 6 s f g Ab t 4 s g
h w s o c d t d u t m d m p l e t t
p l f t e f t h k f the night fem
Wh t m a r c s t r u c t o p a l o d e l t
per t the fr g m t e f d e p t d d
th fem l h e d a l y g l n t f th
a e t b l ty p t f t s t t c h m t th
the l g m t m t e r M a o p m t t
e l e d n t c t t c u l t i l a g e I t j o t f
a s m o o t h h a d g l s t n g A t s p e r o r
p o t b o t / c h s u d t h e f t h e a s
f t p k s h a d f n c o e c t i s l y e r h u c h
p c d d f m t h g f t h l g m t m t
d p a d t h j u t s u f c e f t h t i c u l a r
c a r t i l a g I t s t u m t l y d h e t t h d r
l y g t l g T h p e a m e c u t t h b
m l l y f t o t c y T h p o b a t t h
u t f p e s e t d t h p p e a e o f m k d
a t r p h y G l y t h c a t i l a g f m a l
t h k n p l t t p r p o t b t t h
f w h t w a t h d t H t h c a t l g e
s h d a h y m b d p p h h p
p d t b d t n a h m t f t h d
l y g b h d l m o w O m e r p a m n a
t the p o g a p e s e t d p c t f t m
t p h y t h c u l a c a t l a g a s t a t d

maintained intimately attached to the underlying narrow strip of bone at the osteochondral margin. It appeared to be slightly acidophilic in staining reaction. Most of the cartilage cells had disappeared leaving here and there indistinctly outlined Weichselbaum's lacunae. In places, the cartilage matrix had lost its smooth homogeneous appearance and revealed evidence of separation into parallel fibers (cleavage). From the underlying subchondral marrow, an invasion and replacement of the articular cartilage at its superior portion were noted, forming chondral marrow cavities. Fibroblasts, and thin-walled blood vessels of varying richness from the subchondral marrow, might be seen extending into these spaces. In some places, the cavities appeared so large as to occupy the whole thickness of the articular cartilage with only a thin layer of degenerated cartilage and vascular connective tissue forming their joint surface. In other places, however, they were small and were confined only to the preparatory zone of calcification. Partially or completely lining these spaces, were narrow strips of newly formed lamellar bone. The reaction of the articular cartilage surrounding the chondral marrow cavities varied to a great extent. Where there was a marked degeneration of the surrounding cartilage with a total absence of the cartilage cells and persistence of empty lacunae, fibroblasts might be seen pushing their way from the chondral marrow spaces into the empty lacunae. Here, a proliferation of the fibroblasts might be noted with a subsequent enlargement or dilatation of the invaded lacunae. An apparent transformation of the fibroblasts into cartilage cells proceeded. The nuclei of the fibroblasts might be noted, here and there, to assume a somewhat spherical appearance, and to arrange themselves in twos enclosed within an indistinct cell membrane. At this stage, the ground substance was clear and finely fibrous which, however, gradually assumed its characteristic homogeneous structure as the proliferation of the newly formed cartilage cells proceeded. When, however, some of the old cartilage cells about the chondral spaces escaped the degenerative process in the articular cartilage, they have undergone proliferation as a reaction to the invasion and vascularization from the subchondral marrow. Their lacunae elongated perpendicularly to the joint surface and appeared to contain from 4 to 16 well staining cartilage cells. Here and there, islands of newly formed hyaline cartilage might also be seen scattered on the joint surface of the articular cartilage. They appeared to arise by metaplasia from the cells of the deeper layer of the pannus. The islands of hyaline cartilage thus formed were apparently limited in extent.

Obverse of their logically assumed nutritive role, the blood vessels of the underlying subchondral marrow may show an apparent proliferation and prove to be the active agent in the invasion and resorption of the deeper



Fig. 3 Newly formed articular cartilage about a chondral marrow. *a*, Newly formed cartilage cells, *b*, calcification of the cartilage matrix, *c*, preparatory zone of calcification, *d*, subchondral marrow. $\times 90$

layer of the degenerated articular cartilage at its superior or central portion. This vascularization initiates subsequently the formation of new hyaline cartilage and lamellar bone in the old articular cartilage (enchondral ossification) which leads in some instances to a complete reformation of the greater part of the articular surface.

CASE 3 Female, 58 years of age. The femoral head was removed 4 years following complete intra capsular fracture of the neck with complete separation of the head. On gross examination, the femoral head was found to be somewhat flattened at its superior portion about the region of the fovea. The articular cartilage appeared to be intact, whitish, clear, and shiny. At its flattened central portion, the cartilage was evidently thinned out, an area about 2 centimeters in diameter. The underlying spongiosa was distinctly visible through this thin, bluish articular cartilage. On sawing, the femoral head cut easily with an abnormally soft consistency. The microscopic examination presented a picture of high grade atrophy. The spongiosa was made up almost entirely of fat and poorly cellular marrow and thin walled blood vessels. Embedded in this extremely fatty marrow were occasional small fragments of bone with well staining nuclei. The articular cartilage was intact although it showed marked thinning at the superior or central portion. It stained homogeneously less basic than the normal and, as in other cases, had the tendency to slightly acidophilic staining reaction. In one place at the superior portion of the articular cartilage, there was a total absence of cartilage cells and the matrix revealed an evidence of beginning separation into lines of cleavage, parallel to the joint surface. Even the cartilage lacunae could not be seen in most places. Now and then some faint and obscure and



Fig 4 Ph t gr ph f f m l h d s s f l w
m p l t t p l f t f t h k A t l d
t l cartilg d b th l l h d l y f m d
t l g

r g l l h p d light r a m g h t b e s e t t h
mat w h c h s g g e t e d t h e p u p e c f
ca tilage la u e Occa o lly le m l l h u s h
bod m g h t b e n t d n s m e f t h e s h h
app n tly e e m a s o f t h e o l d c a t l a g e c l l s
All ab ut t h e f o e h o a c t f m a t o f
e h y l c t i l g p l c g t h t d p t h o f
t h e t u l a c a t l a g e s n I n t h s e g t h e
h a l g o n d u b s t a c t d l g h t t h e
s r o n d g m t l t o d e l a y f m t h p k
s h c i d o p h l s t a f t h m m d t e v n t y o f t h e
l y f o m d t l a g e c l l T h l x
e l n g t d n d d p e d m e o l p
p e d u l a l y t t h e i o t f a e T h t l g e l l s
s t a e d r y l l w t h h e m a t o v l n d m b c
l m 4 t o 6 a l a a T h s p f l l
m a d e p f f a t t d a t l g c l l a a g d p a l l t
t t h j t f T h l d p e p t
a l c f t n h e d f g m t a o p l e t h
p l m e t b e l y f o m d l g h t e r t g
h y l e g d b f a c h h e l y f m d
c t l a g e l l e f d T h e t u l g p l f a
t a t d l y b t h m m e d a t g h b o
h d f t h e g h e c l u a t f t h
t c u l t l g f m t h e d l y g m h d
d f d c p l m t f t h d e
g e t d t c l c a t l g d c t t o t h a e f
w t l a g f m t c u l d f b e
U l k C h m l u n d a t e d g t
e l l w e r f u d f t h m t h h n d l m
p e t h f m d h b t d h p l s e f
d l a t d b l d s l s a f w l y m p d l l d
f i b b l t T h l s m g h t b t d h e k i g
t h a y t h g h t w t p f b a t t h e
t e h d l m g N t p f l
f r m e d l m l b n l d t h c a t A t u d y
f e r l s t o l d t t t h s e p t e d d t
p e a d l a r l l y p l g t h d g t d c a t l g
t c A a r u l t h p f i c l l y f t h
c a t l g e f f d f t m t h d g e t p
h b b c a m l m k d t t d d t o t h
d p r l y e T h d c d b y t h f m
f i n d g o f e m p t y c a t l a g f c u x t h e f m

s o m e t m e h s o e t h c c r e d a s g n o d p p
n c f t h a t i l g e c l l s n b u t t h e c i 6 d
l y e t t a s t t g t n o t e t h a t n a t a n
l a t a l l y l g t h r c u m f c f t h e f e m l h d
t h e h d l a t y p o e d d d s e t d i t s y
h t n t h e d g n e t e d p e f i a l l a r d t h e
t l l a b e m d d l a t l g e l a y t t f q l y
d g t h e p c s t h e p r i c a l l y e g r d l
l y a h h d a d p l e d b y t h a d c g h d l
s p c n d t h e p n s h h m g h t b e e t d g
f r m t h e e g n f t h e f o l s d f e h b e
a t l a g a n d t i m e w t p f l m l b o
h c h h a d h e f o m e d f o m s o m e f t h l i b e
d e p l y e f t h p a u m g h t b f d o a d
t h p i l l y m p l e t e l y c g t h e b d l
a v i t y l p i c s t h e l y f o m d l m l b o
a m e d t h e g l p p e e f u b c h d l b o
t o h c h t h e w h y l c a t l g f m t h e p a u s
a t t h d T h e h t l g l n d g l d m
t o a d m t f n d b t m a g n t h e p o b l
m e t h d y h h t h e l d a d d g t d t u l
c a t l a g m g h t b e e d l y d d d p l d
f o m t h n d e l y n g m a w A n t p e t t t h t
p s u t d t l f e y f u b l y s t h t d f m
t h e m u l t i u l d g a t c e l l s o p t n f t h
c a t l g m g h t l b d e t t h e t t f t h e
n d g h l d s l l t h m W b e
a t u l x t n f t h l d r t c l c a t l g
s t h c a s w g g t h e l s o b
q e t a p d d s f e t f m a t o f w e a r t l a g e
f m t h e d a v p l i f t f t h e r g
e l l s o f t h l d a i l g p p t h t h e p i a
m n t l s l t t h s e a m p l t l y
f m d t l t l g h e t h s o f t
p c h d t l e p l a

Not infrequently however the formation of new hyaline cartilage from the proliferation of the old cartilage cells is not active enough to replace the resorbed articular cartilage. Consequently a defect in the articular cartilage usually at its superior portion may be noted. This may be illustrated by the following case

CASE 4. F m l s 3 a o f g e t h
d c d m p l t e t c p l f t u e f t h l
f t h f e m f e a l y s s t a d i g O m l
f t h f m l h d t s f n d t h a d i f
m s n g y e t m t e n d m t t t s p e
p t T h d p d e t o l s s f i c u
l c a t l g d p a t l t h d l y g p o g n a
d s i l l d t h m l i f t d f m t
p o f b o e l y g l v t t h t c l a
c a t l g b m e d i t l y b t t h e s t h a n d
m a d p f e g u l c s f i g h t n g d
b l h c t l a g F e t r a d f i b t i s s
f d h c t l g t t t h d f t O m i s c p
m t t h f m l h d h d p t f
p t l l y g d t h d f h t c u l a
c a t l g p t d c y t t g p p e a
A h l t p t l l y d g t d t h

presence of numerous empty cartilage lacuna. That part of the articular cartilage covering the still necrotic and unreorganized part of the head, showed no signs of invasion of it by the underlying marrow, and, consequently no formation of new cartilage from some of its surviving cells. Occasional islets of newly formed hyaline cartilage formed from the pannus might be seen on its joint surface. An entirely different picture, however, was presented by that part of the articular cartilage covering the reorganized but atrophic portion of the femoral head. It showed a part of the defect in the cartilage as seen on gross examination. There was an active invasion and replacement of the cartilage from the underlying marrow. Fibroblasts, a few thin walled blood vessels and lymphoid cells from the marrow pushed their way up to the region of the cartilage, absorbing and replacing the latter in their course. The cartilage consequently exhibited newly formed chondral spaces filled with fibroblasts, a few lymphoid cells, and, unlike the preceding case, a few blood vessels. Partially lining these chondral cavities, narrow strips of newly formed lamellar bone which assumed the appearance of subchondral bone might be found. From about the region of the tovea, a layer of thin vascular connective tissue (pannus) extended along the joint surface of the central portion of the cartilage and the defect in it. Along the margin of this depression, islands of newly formed cartilage were seen. In this region, the deeper layer of the pannus appeared to assume an embryonal appearance and gave rise to the formation of cartilage by metaplasia. Evidence of a slight proliferation of cartilage cells about some of the chondral cavities might be noted.

Similar processes as have been encountered in the atrophic femoral heads may also be seen in the acetabulum. The following case shows that the acetabulum may also undergo marked atrophic change, its articular cartilage degenerate, and be subsequently invaded and vascularized from the underlying marrow. Formation of new hyaline cartilage both from proliferation of some of its surviving cartilage cells and from the pannus overgrowth of its joint surface may also occur.

CASE 5 Female, 58 years of age, whose hip joint which showed complete intracapsular fracture of the neck of the femur of $3\frac{1}{2}$ years' standing, was available for study following necropsy. The articular cartilage of the acetabulum was found partially covered by a thin sheet of fibrous tissue apparently proceeding from the region of the ligamentum teres. The cut surface of the acetabulum showed an interesting picture. At its central portion, about the region of the ligamentum teres, two layers of articular cartilage were noted separated by a thin area of bone.



Fig 5 Photomicrograph of the superior portion of the articular cartilage. *a*, Chondral marrow cavities, *b*, old articular cartilage with cartilage proliferation, *c*, newly formed bone partially lining the cavity, *d*, multinucleated giant cells, *e*, subchondral marrow. $\times 75$

On microscopic examination, the spongiosa was found to be markedly atrophic. The articular cartilage was intact throughout its whole extent. The cartilage cells stained quite well although, here and there some of the cells were missing leaving empty and dilated lacunae. The cartilage showed at its superior portion chondral spaces which were apparently due to an invasion and replacement by the underlying marrow. These cavities contained normal marrow, with a few thin walled blood vessels and lymphoid cells, and were partially lined by narrow strips of newly formed lamellar bone. They extended laterally along the circumference of the acetabulum between the degenerated superficial layer and the deep calcified region of the articular cartilage, with absorption and total replacement of the former by the marrow of the chondral spaces. During this lateral extension of the spaces, the newly formed lamellar bone lining its margin also participated in the process. Formation of new hyaline cartilage on the newly formed lamellar bone proceeded in the deeper layer of the pannus, and thus presented a picture of a newly formed articular layer. Proliferation of some of the surviving cartilage cells might also be seen about the chondral cavities.

DEDUCTIONS

It is obvious from the foregoing histological findings that articular cartilage, may, under certain circumstances, undergo degenerative change, as may be encountered in the articular cartilage of the hip joint following complete



F 6 Ph t m g ph h ing th rta l cartil g
 bout th l P pcc di g f m th g n f
 th lig m t mt nd ring th ; at d f th
 cartilag b wly f m d rtd g f m m f th ll
 l th pann ld tcul cartil g d l f d r g
 l th tlg bch dal bo f b ho d l
 m w X5

intracapsular fracture of the neck. With the degenerative process the same articular cartilage may show evidence of active proliferative change which consists in the formation of new hyaline cartilage. This is produced by the proliferation of the surviving cartilage cells especially of the deeper layer which have escaped the degenerative process and is prominent in the superior or central portion of the articular cartilage to which according to the general view slight or no power of regeneration is ascribed. In certain cases the proliferation is so marked as to replace the whole thickness of the old articular cartilage and may extend along the greater part of its lateral circumference. Overgrowth of vascular connective tissue (pannus) may be noted proceeding from the attachment of the ligamentum teres and certain cells in its deeper layer may form new hyaline cartilage by metaplasia. The new cartilage however formed through the latter process is limited in extent and is seen only in irregular islets on the joint surface of the old and degenerated articular cartilage. While finishing this paper Freund's article on "Microscopic Processes in the Femoral Head following Fracture of the

Femoral Neck" appeared. He also noted in some of his cases a proliferation of the old cartilage cells and formation of new hyaline cartilage from the pannus. This has been frequently encountered at the pressure portion (*Druckschicht* in the German) of the articular cartilage from which he assumes that the pressure or injury resultant from the fracture is likely the actual cause of the proliferation as the combination of strain, injury and proliferation is a phenomenon which cartilage not infrequently presents. Such an assumption can not altogether be given serious consideration since it can be proved by serial sections that marked proliferation of some of the surviving cells of the articular cartilage may also be noted even along the lateral circumference of the femoral head where the influence of injury is least but where the chondral marrow space has extended. Besides the histological examination of the cases reveals no changes which can well be attributed to injury.

The microscopic picture of these cases seems to suggest very forcibly that the regeneration and proliferation of the old cartilage cells depend to a great extent upon the secondary invasion and vascularization of the articular cartilage from the underlying subchondral marrow. The latter process is invariably present where the old degenerated cartilage is being replaced by the new hyaline cartilage which has been formed by the proliferation of the surviving cells of the articular cartilage and absent where such replacement is not seen as in the other part of the cartilage and in the articular cartilage of the femoral head which has undergone necrosis following the fracture. The histological findings seem to point to the resorptive nature of this process and have a suggestive similarity to that often encountered in atrophic bones. Invasion of the articular cartilage by the underlying marrow has been described before by Pommer. He stated that it is generally a finding in an early case of arthritis deformans. Lang noted it in the acetabulum of arthritis deformans of the hip joint. Similar picture has been described by Heine in the hip joint of a woman 46 years of age who had complete intracapsular fracture of the femoral neck of 3 years' stand-

ing With it, there is a very marked atrophic change in the femoral head and acetabulum, associated with tabetic arthropathy and suggestive signs of secondary arthritis deformans. Other instances of invasion of the articular cartilage from the subchondral marrow have been recorded in cases of tabetic arthropathy. Moritz, in describing one case, noted it together with the presence of proliferation of cartilage cells. He stated that when the cartilage proliferation is absent, the enchondral ossification in tabetic arthropathy can not be demonstrated. The invasion by the marrow causes the articular cartilage to be thrown into folds (*Faltenbildung* in the German) with or without the attached preparatory zone of calcification. Freund, in his microscopic study of the processes in the femoral head following the fracture, included 3 cases of tabetic arthropathy in his report. He also noted in the articular cartilage similar changes as observed by Moritz. It is of utmost interest that in no case described in this present paper is there evidence of arthritis deformans or tabetic arthropathy. An interpretation that many of the sections presented in themselves very forcibly is that the active agent in this replacement or resorptive process of the degenerated articular cartilage, may be one or possibly a combination of the following (a) the multinucleated giant cells, (b) the medullary connective tissue, and (c) the blood vessels. In Figure 5 is shown a number of multinucleated giant cells within the newly formed chondral spaces and in the subchondral marrow immediately adjacent to them. These cells can be seen in no other place in the femoral head. They are invariably present where the replacement of the cartilage is taking place. This picture seems to show that the multinucleated giant cells are probably the active agent in the absorption of the cartilage in this particular case. As yet, this remains only an assumption because of the failure actually to note, from the microscopic study, evidence of ingested cartilage within the cells' protoplasm. Other cases in which this resorptive process in the articular cartilage is active reveal, however, a microscopic picture indicating a total absence of multinucleated giant cells, but, on the other

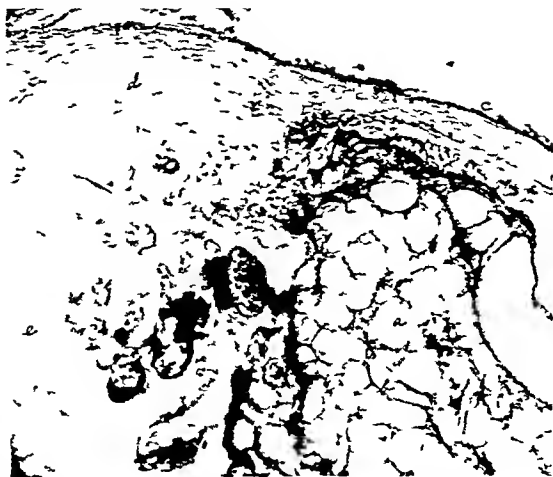


Fig 7 Photomicrograph showing, *a*, a part of the chondral marrow cavity, *b*, chondral marrow and bone, *c* pannus partially covering the joint surface of the superior portion of the articular cartilage, *d*, newly formed cartilage from the cells of deeper layer of the pannus, *e*, newly formed cartilage from the cells of the deeper layer of the old articular cartilage. $\times 75$

hand, there is a marked predominance of young, active fibroblasts. These cells are seen pushing their way from the marrow into the overlying cartilage which they partly absorb and replace, and, in this way, chondral cavities are formed. It may therefore, be assumed that the invasion of the cartilage may be ascribed to the lytic function of the fibroblastic tissue of the subchondral marrow. The articular cartilage may, in some instances, be mainly invaded and replaced by the blood vessels of the marrow. Not infrequently rich plexuses of thin walled blood vessels filled with red blood cells may be seen extending from the subchondral marrow into the marrow spaces which are formed in the articular cartilage.

Islands of newly formed cartilage cells may be encountered about the chondral marrow spaces. From many of the sections, it appears as though this is due to a marked proliferation of some of the cells in the deeper layer of the articular cartilage which have escaped the degenerative process in the cartilage. There is an apparent regularity in the relation between the amount of new hyaline cartilage formed from the surviving cells of the articular cartilage and the degree of vascularity in the



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H a t t e m p t t n a d p l m t f m t h
d l y g e c i m r d s e q t h y t h e
f m t o f e h y l t l a g e t h f m t h
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F g 8 P h t m g r p h s b v g p t f t h
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adjacent chondral marrow spaces which more than suggest that the blood vessels in the chondral spaces are possibly the active proximate agent in the new formation of hyaline cartilage. The fact that the islands of newly formed cartilage are invariably present where the old cartilage is being replaced by the underlying marrow furnishes a plausible support to this assumption. In cases however in which the femoral head becomes necrotic following the fracture an invasion of the articular cartilage from the underlying subchondral marrow and therefore the subsequent proliferation of the cells of the articular cartilage do not occur. This observation seems to show further that the above assumption is tenable and may be well illustrated by the following case:

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m o d M c r s p c m t l d
c t i v e r o g i z t f l m t h f f t h
n e o t c p o g a T h a i l c a t l g l y g
t h e r o r g i z e d b t m k e d f t p h c p t f t h
s p n g i a h e d a b y t h d h g
b h o d a l m r w t h f m l f w h y l
c t l a g e f m t h p l f t n f m f t h e l l f
t h e d e g e r e d t l a r c a t l g W t h t h t h
v a s l s o e n l y r f e w h y l c i l g t h

Where the chondral cavities are very richly vascular a rapid and marked formation of new hyaline cartilage and subjacent lamellar bone from the proliferation of the cartilage cells with a complete and efficient reformation of the articular layer occurs as rapidly as the latter is being invaded and replaced by the underlying marrow. But if the vascular supply within the chondral spaces be meager then subsequently this formation of new hyaline cartilage and lamellar bone is not as rapid and sufficient as the old articular cartilage is being absorbed and replaced by the underlying marrow. This leads therefore to the occurrence of a defect in the articular surface which may later—although gradually—be covered by new hyaline cartilage generally formed from the pannus. Now and then some of the cells of the deeper layer of the pannus differentiate and form localized islets of hyaline cartilage with or without intimate attachment to the articular surface of the joint. A number of these newly formed cartilage cells may also show appearance of undergoing direct transformation into bone cells and in this way present a picture of the existence of a layer of hyaline cartilage covered lamellar bone (articular layer) interposed between the two articular surfaces of the hip joint. When this mode of formation of new hyaline cartilage occurs it is generally found in close proximity to and overlying the chondral marrow cavities as well as the regions of proliferating cells of the articular cartilage. Not infrequently however it may be encountered arising from that part of the pannus farthest removed from the chondral spaces. Still in some instances there is a complete failure of formation of new hyaline cartilage from the pannus as can readily be

seen, now and then, in the femoral head which underwent necrosis following the fracture. In this particular connection, instead of acting as a factor in the reconstruction of the articular surface, it may show marked activity in the absorption and erosion of the articular cartilage along its joint surface.

We are now confronted with the demand for an explanation of the cause of the degeneration that one may, now and then, observe in the articular cartilage of the femoral head following complete and unreduced intracapsular fracture of the neck. A worth while and convincing explanation from a study of the histological sections is not forthcoming, as it seems that we are dealing here with a problem which ought to be considered mainly from the biological standpoint. It may, however, be assumed that a change in the nourishing property of the synovial fluid which has been brought about by the fracture, and, possibly the lowered resistance of the articular cartilage of elderly individuals to such a change may partly account for the degeneration of the articular cartilage. That the atrophy has, perhaps, nothing directly to do with the process seems quite clear from the fact that degeneration of the cartilage and consequently its invasion and replacement from the underlying marrow have not been encountered in other cases of markedly atrophic femoral head, as, in senile osteoporosis. In this connection, a short description of the femoral head obtained from an individual at necropsy in whom the most striking feature was a marked and generalized senile osteoporosis of the skeleton, may be enlightening.

In this case a woman, aged 79 years, for the last 4 years had been complaining of vague pains all over the body. In addition she had had multiple spontaneous fractures of many of her long bones in spite of being bedridden. Roentgenograms taken of the bones of the extremities revealed multiple simple fractures and marked atrophy. At necropsy, the femoral head was removed for study. This was found to be very markedly atrophic and showed no gross changes in the articular cartilage. Microscopic examination showed an extremely atrophic femoral head with a marked loss of the bony trabeculae including a greater part of the strip of bone at the osteochondral margin. The articular cartilage appeared intact in spite of the loss of much of the sub-



Fig 9 Photograph of a section of a partially reorganized necrotic femoral head following complete intracapsular fracture of the neck. Note, a, necrotic part of the spongiosa, b, organized part of the necrotic spongiosa, c, intact but partially degenerated articular cartilage, d, invasion and replacement of the cartilage overlying the organized spongiosa by the subchondral marrow, e, proliferating cells of the deeper portion of the cartilage, f, a part of the ligamentum teres, g, fracture surface.

chondral bone to which it was normally attached. It showed a normal structure and revealed a normal staining reaction. The cartilage cells were present throughout except for the presence of a few Weichselbaum's lacunae here and there in the superficial layer.

The assumption that the lowered resistance of the articular cartilage of the hip joint of elderly individuals to the presumably altered nutritional property of the synovial fluid following the fracture might partly account for the degenerative change in it. This was suggested by the case which is reported below.

The specimen was from a colored boy, 9 years of age, who had had complete and unreduced epiphyseal separation of the upper end of the femur since he was barely 3 weeks old. At operation, the upper femoral epiphysis was found almost free in the joint except for its attachment with the ligamentum teres. The articular cartilage was intact and showed no gross changes. On microscopic examination, the epiphyseal cartilage was found to be intact with well staining cells. A prolapse of the epiphyseal cartilage at its center into the spongiosa of the epiphysis (*Knorpelknatchen* in the German) was seen. This prolapsed piece of the epiphyseal cartilage showed normal staining and apparently actively proliferating cells and revealed evidence of ossification about its margin. The articular cartilage was intact and of normal structure. Its cells were present throughout and stained very well.

SUMMARY

In a series of atrophic femoral heads and acetabula following complete intracapsular fracture of the neck degenerative and proliferative changes have been frequently noted in the articular cartilage. Following the degenerative change a resorptive process which simulates that occurring in atrophic bone takes place in the articular cartilage. It consists in the invasion of the cartilage by the underlying marrow starting at its superior portion and gradually spreads along the lateral circumference with absorption and replacement of the cartilage in its course and the subsequent formation of chondral marrow cavities. The process however is observed only in the femoral head and acetabulum where the blood supply remains intact following the fracture but fails to occur in the head which underwent necrosis due to vascular interruption. The resorption may be brought about by (a) the multinucleated giant cells (osteoclastic resorption) (b) the connective tissue (fibroblastic resorption) (c) the blood vessels (vascular resorption) or a combination of these processes.

Following the degenerative change in the articular cartilage and its gradual resorption from the underlying marrow there occurs an active formation of new hyaline cartilage both from the pannus that covers the joint surface of the articular cartilage and from the proliferation of some of the surviving cells generally those in the deeper layer of the articular cartilage. The former process is limited in extent and may also be noted now and then on the articular surface of a necrotic femoral head. The latter process however may at times be so marked as to replace the whole thickness of the articular cartilage and thus leads to a partial or complete reformation of the articular layer. It is usually encountered starting about the chondral spaces and only in alive femoral head and acetabulum which more than suggests the importance of the resorptive process in the subsequent proliferation of the old cartilage cells. Subchondral marrow invasion of the articular cartilage has been noted before in some cases of arthritis deformans and tabetic arthropathy. In the present cases however the

histological examination can not demonstrate any pathological conditions aside from the osteoporosis subsequent to disuse. The part played by the atrophy in the process can not be given really serious consideration since similar changes to those which have been observed can not be shown in senile osteoporosis nor can it be shown in disuse atrophy of the upper femoral epiphysis of 9 year duration.

BIBLIOGRAPHY

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CLINICAL SURGERY

FROM THE KRANKENHAUS WIENEN

THE HALBAN OPERATION FOR GENITAL PROLAPSE¹

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A REVIEW of the anatomy and etiology of genital prolapse (cystocele, rectocele, and prolapse of the uterus) seems essential before an attempt is made to describe the technique of the Halban operation for the relief of these conditions

Halban and Tandler have shown that the female pelvic organs are held in their normal positions by the musculature of the pelvic floor and especially by the levator ani muscles. This muscular pelvic diaphragm closes off the pelvic outlet from below and serves to prevent a caudad displacement of the pelvic genitalia, due to the influence of intra-abdominal pressure. In addition to this muscular apparatus which is the main factor in the maintenance of the physiological position of the pelvic organs, there is a second very important structure which also serves as a means of organ fixation, namely the fascia endopelvina.

This fascia-like connective tissue is a direct continuation of the fascia endo-abdominalis. It lines the entire true pelvis exactly as the fascia endo-abdominalis lines the abdominal cavity and the fascia endothoracica the thoracic cavity. This fascia covers the uterus, vagina, bladder, and rectum. As it covers these structures it undergoes hypertrophy and thickening and is, therefore, most developed at these points. These visceral portions are known as the fascia visceralis (Figs 1, 2, 3, 4). The pelvic organs are thus covered by a connective tissue stroma which acts as a support or scaffolding structure which helps to maintain positional stability.

The structure of this fascia is, to a large extent, dependent upon its functional requirements. For the most part, it is thin and delicate but undergoes marked hypertrophy and hyperplasia in those areas in which it functions as a true supportive structure. Obviously then this fascia is best developed in the weakest portion of the pelvic floor since it is at this point that intra-abdominal pressure can exert its greatest force

against the positional stability of the pelvic organs. This weak spot is at the genital hiatus where the muscular pelvic diaphragm of the pelvic floor is deficient.

The portion of this fascial sheath which covers the floor of the bladder is united with that portion which covers the anterior vaginal wall. Together they form a markedly thickened and powerful layer of fascia known as the fascia vesicovaginalis or vesicovaginal septum. Similarly the fascia of the posterior vaginal wall unites with that of the anterior rectal wall to form the fascia rectovaginalis or rectovaginal septum (Fig 5).

The uterine portion of the fascia endopelvina also acts as a supporting structure for the uterus. It radiates outward from the uterus to the parametrial tissues, becoming hypertrophied at its junction with the uterosacral ligaments posteriorly and laterally and with the vesico-uterine ligaments anteriorly. These uterine ligaments are therefore strengthened by these portions of the fascia endopelvina (Figs 6 and 7).

An understanding of the anatomical relations as described will furnish the explanation for the development and consequently the repair of cystocele, rectocele, and prolapse of the uterus.

Cystocele is the most common form of genital prolapse and results, in the vast majority of instances, from lacerations of the supporting structures of the bladder. These lacerations, involving muscularis, connective tissue, or both, are practically always due to the trauma of labor. If one component of the pelvic floor has been damaged, its function can be carried on for a varying period of time by the other component supporting structure, provided these latter remain intact. Eventually, however, the intact portions must weaken. Prolapse of the anterior vaginal wall and of the bladder cannot result from even a complete or third degree laceration of the perineum—evidence that the intact fascia vesicovaginalis can and does maintain the anterior vaginal wall and bladder in

¹Translated by Ralph A. Reis

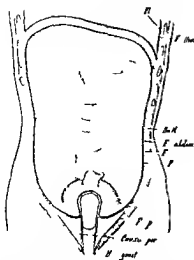


Fig 2. Transverse section of the pelvis showing the uterus, ovaries, and surrounding ligaments and muscles. Labels include: F. the, F. abdus, F. p, Cervix per, H. gnat.

their normal positions. This is true in spite of the marked trauma to the levator ani muscles.

Conversely, cystoceles develop following injury to the fascia even though the levator muscles remain intact. Finally, as so frequently happens, both fascia and musculature are damaged, following which a cystocele must of necessity develop.

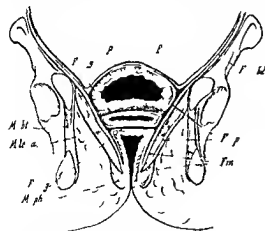


Fig 3. Transverse section of the pelvis showing the uterus, ovaries, and surrounding ligaments and muscles. Labels include: M. H., M. Le., F. p, F. m, M. ph.

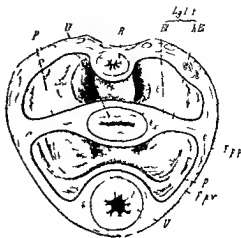


Fig 4. Sagittal section of the pelvis showing the uterus, ovaries, and surrounding ligaments and muscles. Labels include: Lg. l., F. p, F. m, F. p, F. m, F. p, F. m, F. p, F. m.

Similarly, rectocele results from lacerations of the connective tissue of the septum rectovaginalis.

Lacerations of these same supporting structures play an important rôle in the development of descensus and prolapsus uteri. In addition, however, a second condition must be present, namely, that the uterus has come to lie retroversion. The normally anteverted uterus becomes pressed against the pelvic diaphragm by a y crease in

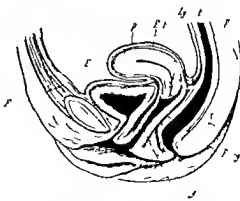


Fig 5. Sagittal section of the pelvis showing the uterus, ovaries, and surrounding ligaments and muscles. Labels include: Lg. l., F. p, F. m, F. p, F. m, F. p, F. m, F. p, F. m.

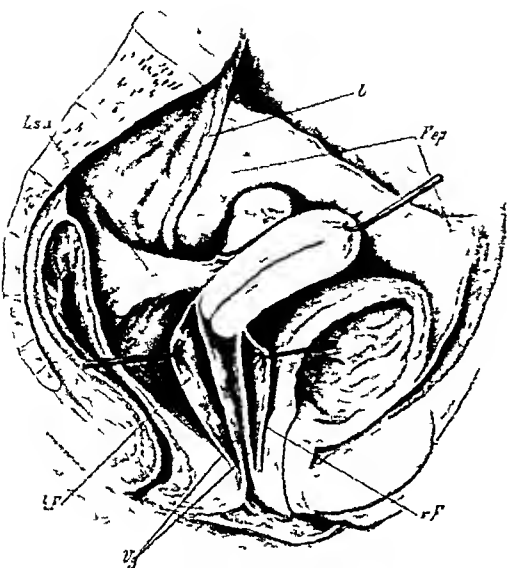


Fig 5 *Fep*, Fascia endopelvina, *hF*, rectovaginal septum, *Lcu*, lateral vesico-uterine ligaments, *U*, ureter, *vF*, vesicovaginal septum, and *vg*, vagina

intra abdominal pressure. This action obviously increases the normal anteversion. With the retroverted uterus the opposite results as loops of intestines are forced down into the vesico-uterine space by increased intra-abdominal pressure. The uterus can be forced downward into the axis of the vagina only when the uterine axis parallels the vaginal axis. Under this latter condition, intra abdominal pressure can force the uterus to descend and finally to prolapse through the genital hiatus of the pelvic fascia (Figs 8 and 9).

Elongation of the cervix is a very frequent accompaniment of uterine prolapse, due to prolonged pressure on the prolapsed part. Prolonged pressure on the cervix of a markedly anteverted uterus—especially following a surgical correction of uterine displacement—may result in the development of a cervical elongation and so lead to the development of prolapse by long continued pressure on the elongated portion (Fig 10).

The Halban operation for genital prolapse is based on the anatomical facts described. The operation itself is made up of several important procedures. First, reconstruction of the connective tissue, fascia, and muscular supporting structures by reefing of the vesicovaginal fascia for the relief of cystocele, of the rectovaginal septum for the relief of rectocele, and suture of the levator ani muscles when lacerated or separated. Relief of urinary incontinence is, as will be shown later, secured by means of the same procedure

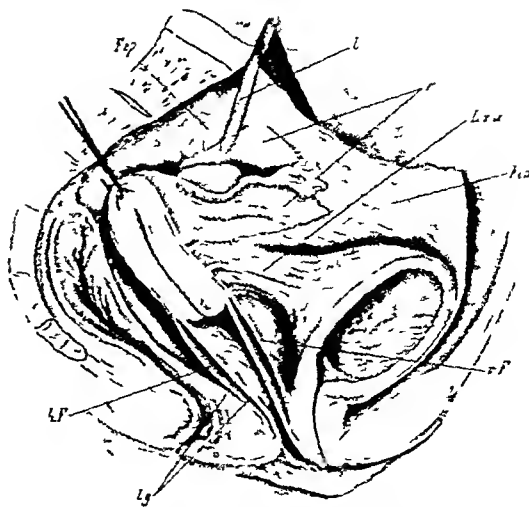


Fig 6 *Fep*, Fascia endopelvina, *hF*, rectovaginal septum, *Lcu*, lateral vesico-uterine ligament, *P*, peritoneum, *U*, ureter, *vF*, vesicovaginal septum, and *vg*, vagina

Second, the position of the uterus, when retroverted, must be restored to normal. This restoration of normal anteversion must include a prevention of the recurrence of the retroversion. It has been found that this can best be accomplished by a "high vesical fixation" which obliterates the vesico-uterine space. Interposition of bowel between bladder and uterus is therefore no longer possible. The intestinal coils can fall into the Douglas only if pressure can be exerted on the

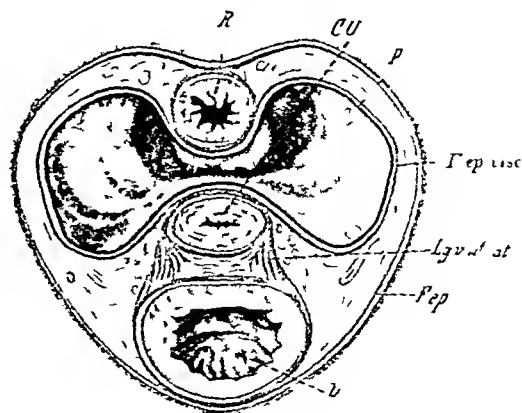


Fig 7 Cross section of the pelvis at the level of the cervix uteri. *CU*, Cervix uteri, *Fep*, fascia endopelvina parietal sheath, *Fep visc*, fascia endopelvina-visceral or subserous sheath, *Lg ut lat*, lateral vesico-uterine ligament, *P*, peritoneum, *R*, rectum, and *V*, bladder



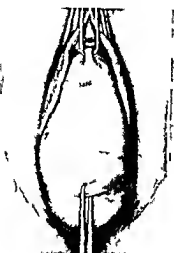
Fig 8



Fig 9



Fig



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Fig



Fig 3

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poster or uterine wall alone. Such pressure must result in an increased and continued anteversion. An important step in the satisfactory production of this anteversion is the amputation of the cervix.

TECHNIQUE

The technique is as follows: The patient is in the prone position. The pre-operative preparation includes decubital ulcers and marked edema and swelling of the perineum. These are corrected by reposition of the uterus and bed rest. Ulcerations are rendered comparatively sterile by

application of the culture of iodine. It is not necessary to a complete healing of the perineum. The actual cautery is used to correct any cervical pathology present.

The operation is usually performed under general anesthesia but can be successfully carried out under local infiltration. The latter is used chiefly for women of advanced years and is comparatively simple. A 5 per cent solution of novocain or 2 per cent solution of tetracaine is used. These are injected first into the perineum posterior of

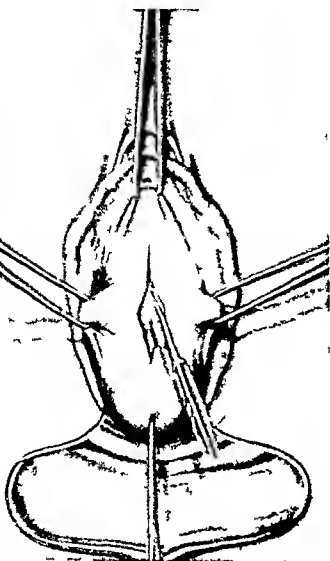


Fig 14

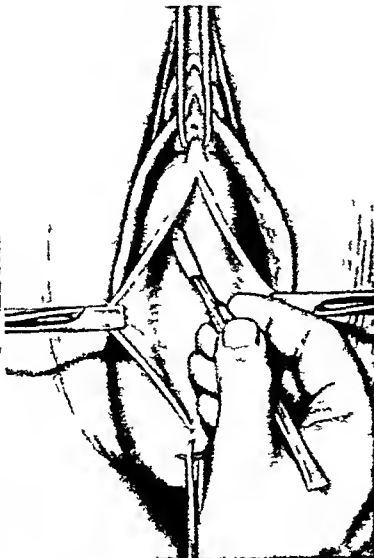


Fig 15

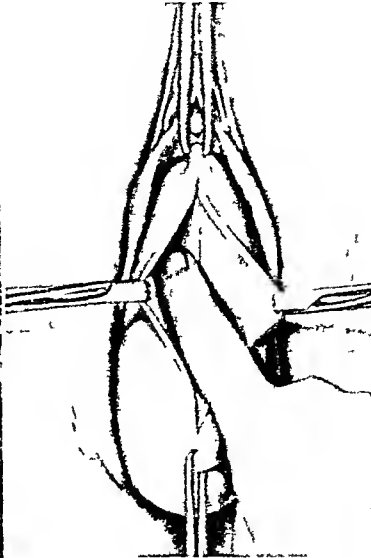


Fig 16

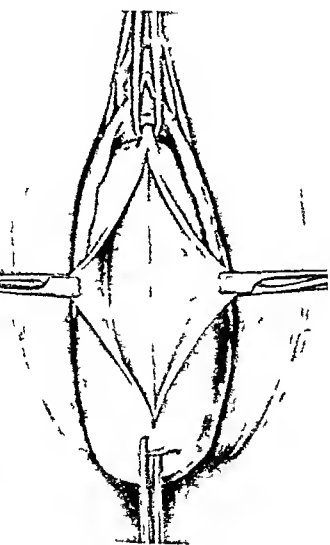


Fig 17

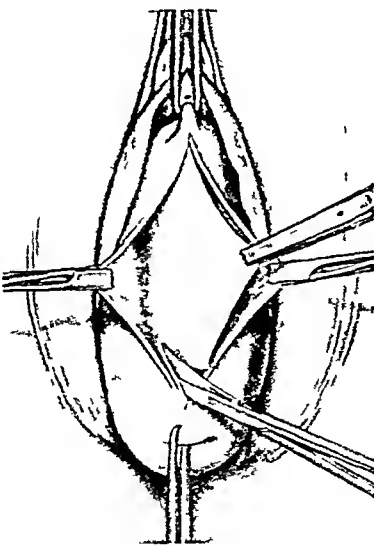


Fig 18

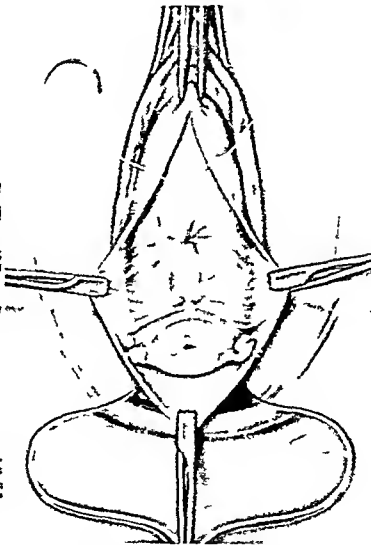


Fig 19

Fig 14 Moderate vaginal descensus The anterior vaginal wall is incised longitudinally

Fig 15 The vaginal flaps are dissected free from the underlying fascia

Fig 16 The separation of vaginal mucosa from underlying fascia and bladder is continued laterally by blunt dissection

Fig 17 The vesicovaginal fascia has been separated from the vaginal mucosa on the right

Fig 18 The vesicovaginal fascia is dissected free from its attachment to the uterus

Fig 19 Suture of the vesicovaginal fascia by purse-string sutures

vaginal vault, and the retrocervical space and finally into both parametria The latter are reached through the lateral vaginal fornices The anterior vaginal wall rarely requires infiltration

Other operative procedures, such as the removal of polyps, dilatation and curettage, etc., are always carried out before the prolapse operation itself The actual operation must *always* begin

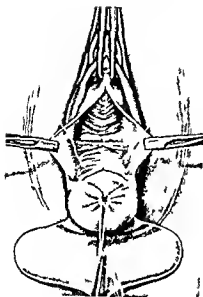


Fig 3

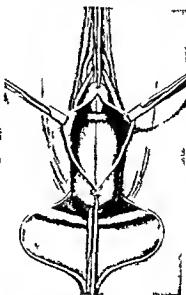


Fig 4



Fig 5



Fig 3



Fig 4



Fig 5

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with an estimation of the length of the uterus. This is most important. If uterus is more than 8 centimeters long the cervix must be ascertained.

The anterior vaginal wall is placed to the stretch by the pessary placed just below the external urethral orifice and the anterior vaginal wall is placed to the stretch.

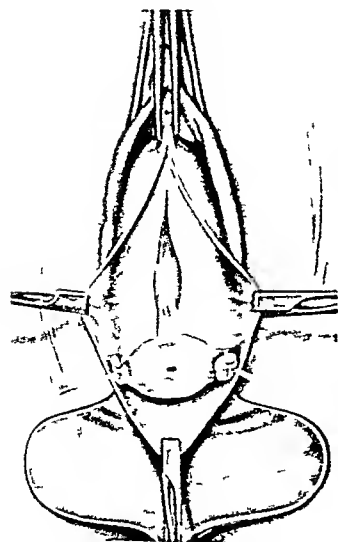


Fig 26

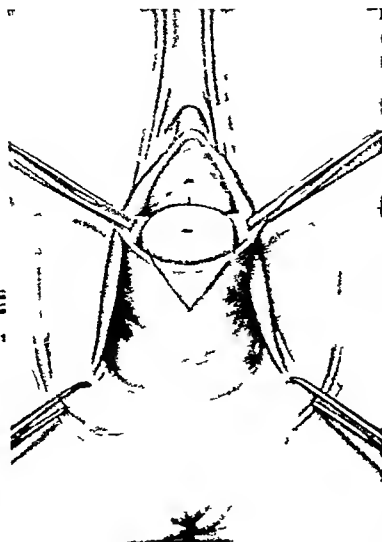


Fig 27

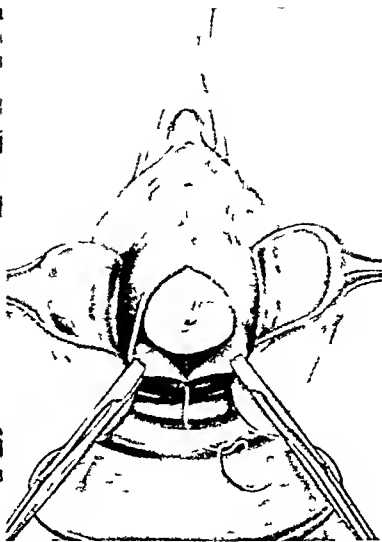


Fig 28

Fig 26 The amputation of the cervix has been completed

Fig 27 Following cervical amputation a triangular piece of posterior vaginal mucosa is removed

Fig 28 The posterior cervical lip is covered over with posterior vaginal mucosa following removal of the triangular piece of mucosa (Fig 27). This permits of more marked posterior displacement of the cervical stump into the recto-uterine space than without such resection

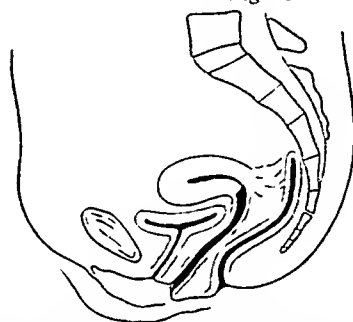


Fig 29 Sagittal section of the pelvis following cervical amputation. The cul de sac of Douglas has been obliterated and the cervical stump can no longer be affected by intra-abdominal pressure. Compare with Figure 10

11) If the prolapse is not a complete one and if the anterior vaginal wall cannot be brought forward readily (Fig 12), it is brought forward by two laterally placed vulsella (Fig 13). A longitudinal incision, extending through the mucosa and underlying fascia, is then made on the anterior vaginal wall and exposes the bladder (Fig 14). The lateral vulsella are now removed and the mucosa flaps dissected laterally by sharp dissection, thus separating the mucosa from the underlying fascia (Fig 15). After the cut edges of mucosa and fascia have been separated by sharp dissection, the separation is continued laterally, as far as possible, by blunt dissection (Figs 16 and 17). This blunt dissection must be carried laterally to the levator muscles. At this point there is usually marked venous bleeding which, however, can be controlled without difficulty. The lower end of the vesicovaginal fascia is now dissected free from its uterine attachment (Fig 18). Following this step the bladder can be readily freed from the anterior wall of the cervix. Bleeding which always results at this point from trauma to the inferior vesicle artery, must be controlled by ligature. The fascia is next sutured by interrupted catgut sutures (Fig 19). If the cystocele

is a large one, then the fascial slack (Fig 20) is first taken up by one or more pursestring sutures (Fig 19). Enough interrupted sutures must be used to make a firm fascial sheath (Fig 20). It should be emphasized that the vesicovaginal fascia can be found and dissected free in every instance.

For the relief of accompanying incontinence two so called 'sphincter stitches' should be used. Two transverse sutures are placed high at the junction of the urethra and bladder so as to bring the lateral connective tissue together in the midline. The formation of this transverse band produces an angulation and kinking of the urethra and functions as a sphincter muscle (Fig 21). Following resection and resuture of the fascial layers, the cut edges of the vaginal wall are reunited with catgut in those instances in which vaginal descensus and cystocele occur alone. The

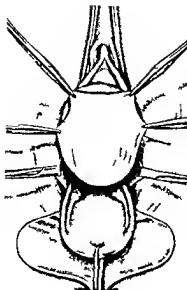


Fig 3

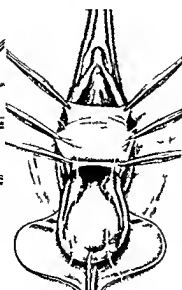


Fig 3

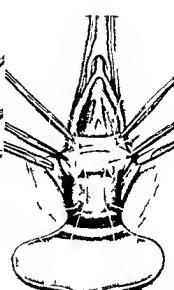


Fig 3

Fig 3 High vesicofixation. The bladder is fixed to the abdominal wall above the uterus. The uterine artery is ligated and the uterine corpus is amputated. The bladder is fixed to the abdominal wall above the uterus. The uterine artery is ligated and the uterine corpus is amputated. The bladder is fixed to the abdominal wall above the uterus. The uterine artery is ligated and the uterine corpus is amputated.

Fig 3 The fixed position of the bladder is shown. The uterine artery is ligated and the uterine corpus is amputated. The bladder is fixed to the abdominal wall above the uterus. The uterine artery is ligated and the uterine corpus is amputated. The bladder is fixed to the abdominal wall above the uterus. The uterine artery is ligated and the uterine corpus is amputated.

dead space between the vesicogenital fascia and the vaginal mucosa is always obliterated by including the former in the uterus which reunite the latter.

When accompanied by descensus or prolapsus of the uterus it becomes absolutely necessary to correct the uterine retroversion by means of the high vesicofixation. In addition the cervix must be amputated whenever the uterus is more than 8 centimeters in length. This is performed as follows: The anterior vaginal wall is incised longitudinally as described with the vesicogenital fascia isolated, developed and cut free from the cervix. The bladder is freed from its cervical attachment and pushed up and by blunt dissection until the vesicouterine reflection of the peritoneum is reached. The cervix is then circumcised and the excess anterior vaginal mucosa is resected by two incisions which begin just below the external urethral orifice and extend downward and laterally and encircle the cervix to meet posteriorly (Figs 2, 3 and 4). The lateral and posterior vaginal mucosa is dissected free from the body of the cervix by blunt dissection. The descending branch of the uterine artery on either side is dissected free and ligated separately. These ligatures must include some cervical tissue (Fig 25). The upper end of the exposed anterior cervix

is grasped by means of vulsellae at a level above that of the ligatures on the uterine arteries. The cervix is then amputated by straight scissors at a level just below that of the uterine artery ligatures. This should leave a uterus less than 8 centimeters in length (Figs 25 and 26). If the cul-de-sac of Douglas is opened during the cervical amputation the peritoneal cavity is closed off by a running suture.

A triangular piece of peritoneal genital mesosac is reflected (Fig 27). The retrocervical space is not deepened as much as possible and the posterior lip of the cervical stump covered over as shown in Figure 8. By this means the cervical stump is drawn posteriorly so far that the retrocervical connection is such that intra-abdominal pressure can no longer exert any influence on the posterior cervical wall (Fig 29).

The next step is the high vesicofixation. The vesicouterine reflection of the peritoneum is incised, the uterine corpus is brought out through the incision and carried down and as far posteriorly as possible. This latter step is important in order to facilitate the grasping of the bladder peritoneum which is brought out though the vagina as far as possible. It is carried out by placing forceps on the cut edges and exerting



Fig 33

Fig 33 Schematic sagittal section of uterus and bladder. The anterior surface of the uterus is sutured to the posterior surface of the bladder. This obliterates the vesico-uterine space. The bowel can no longer enter this space and produce retroversion. The downward pressure

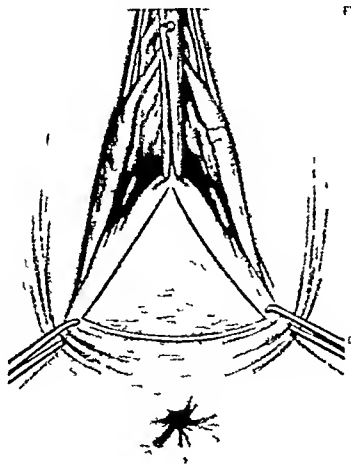


Fig 34

exerted by intra-abdominal pressure produces its effect upon the posterior uterine wall, increasing normal anteversion. Fig 34 Posterior colporrhaphy. Typical Hegar resection of posterior vaginal wall.



Fig 35

Fig 35 Posterior colporrhaphy, perineal suture

downward traction. This is followed by grasping at higher levels with other forceps which pull the bladder down still farther. This process is repeated several times until the bladder peritoneum has been brought down as far as possible without undue stretching or tearing (Fig 30). When a point of definite resistance is met, it will be found that the point of fixation of the bladder peritoneum has been reached. This fixation point of the bladder must be reached and sutured to the uterus. Efficient results cannot be obtained by anchoring any portion of the posterior bladder peritoneum to the uterus. This highest portion of the bladder peritoneum at the point of fixation is now sutured to the posterior surface of the fundus uteri (Fig 31). Further sutures are placed as shown in Figure 32, so as to suture the deeper portions of the peritoneal flap to the anterior uterine wall. At the same time the uterus is gradually replaced (Fig 32). Finally the vesico-uterine reflexion of the peritoneum is closed, the vesicovaginal fascia is sutured as previously described, and, lastly, the vaginal mucosa flaps are reunited, both in the midline and over the cervical stump. Figure 33 shows the end-result of the high vesicofixation which has brought about the obliteration of the vesico-uterine space.

Operative correction of the posterior vaginal wall follows and is carried out in accordance with the pathology present. For slight descensus of the posterior vaginal wall, a posterior colporrhaphy

suffices. A typical Hegar triangular flap is resected (Fig 34). The cut edges of the vaginal floor are reunited in the midline by a continuous catgut stitch and the skin of the perineum with interrupted silk sutures (Fig 35).

When rectocele is present a reconstruction of the posterior vaginal wall similar to the repair described for the anterior wall, must be done. The damaged rectovaginal septum must be strengthened exactly as the fascia vesicovaginalis was reinforced anteriorly. The posterior vaginal wall is split longitudinally from the high point of the rectocele to the apex of the resected triangular area. The lateral cut edges of the vaginal wall are everted by vulsella traction. The fascia is dissected free from the under surface of the vaginal mucosal flap on either side. This is often difficult as the septum is frequently thin and delicate. The rectocele space is obliterated by pursestring sutures which unite the lateral portions of the fascia in the midline. The excess portions of the vaginal mucosa are resected and the colporrhaphy is completed as previously described.

Lacerations of the levator ani muscle or marked separation of the pillars of this muscle must also be corrected. Suture of the levator muscle is accomplished as follows. The puborectal portions of the levator muscle are isolated by blunt dissection. They can be found laterally under the vaginal mucosa flaps (Fig 36). They are drawn toward the midline by means of tissue forceps

FROM THE LINCOLN GENERAL HOSPITAL

OSTEOMYELITIS AND COMPOUND FRACTURES OF THE PELVIS

SPECIAL TECHNICAL METHODS TO BE EMPLOYED IN TREATMENT

H WINNETT ORR, M D, F A C S, LINCOLN, NEBRASKA

OSTEOMYELITIS and compound fractures of the pelvis present certain difficulties in the way of satisfactory surgical drainage, control of the injured and inflamed parts, securing healing of discharging sinuses, and prevention of deformity and disability

Some years ago the writer found himself challenged by two particular problems in dealing with such cases. In the first case a young woman had fallen from a bus in Chicago and was successfully treated there for a depressed fracture of the skull. Upon getting out of bed she was found to have a bad limp on the opposite side from her head injury. This was erroneously attributed to her cranial injury. Upon examination I found that she had had a pelvic fracture which had healed in bad position. By forcible manipulation and fixation in the manner I shall describe the deformity was partially corrected and her limp improved.

The second patient was seen by me some time after her accident with an extreme deformity following a pelvic fracture. She came, however, not for suggestions about her own deformity and disability, but for the treatment of a three year old child with spastic paraplegia (Little's disease), possibly the result of injury at birth caused by the bony deformity of the mother's birth canal. Such cases and experiences occur in the practice of almost every physician and surgeon. They should certainly lead us to ask how such deformities and disabilities may be prevented.

In a considerable number of pelvic fractures the patient arrives at the hospital in a condition of shock. This condition is commonly an excuse for doing nothing to the fracture until it can be determined what are to be the effects of his severe injury upon the patient's general condition. This may, and often does, involve a delay of several days during which shock is unduly prolonged and other infectious or intrapelvic complications arise. If shock is prolonged, and if there are severe bony injuries with poor control of the patient and the fracture, it must be obvious that the restless patient and the uncontrolled fracture fragments greatly increase the danger and severity of such complications.

When there are wounds communicating with the bone these wounds are usually given attention even though the fracture, as such, may be disregarded. The writer desires to call attention to the fact that there is no need for delaying treatment of the fracture, since doing so, contrary to general opinion, tends to prolong shock and to afford the opportunity for further damage by bone fragments that have not been placed in proper position or immobilized. An extensive experience with the writer's method in treating compound fractures and other infected wounds has demonstrated that such conventional treatment of wounds as suturing, rubber tube drainage, and frequent dressings, is inadequate if not actually inappropriate treatment for such conditions.

An article by Bacon seems to reflect the attitude toward these cases of a considerable number of surgeons, especially those who are dealing with laborers injured in the industries. He says "We have learned to dispense with the plaster cast. It does not assist in the maintenance of position even if partial reduction is accomplished." He does advise against the adhesive plaster swathe, as we do also, on the ground that it aggravates displacement of fragments and deformity. Lockwood says that the treatment of intrapelvic complications is operative. He apparently ignores the fracture. Both Bacon and Lockwood seem to lose sight of the obvious fact that intrapelvic as well as other later complications may be avoided by early reduction of the fracture and efficient immobilization which, after all, may be attained (see report of Case 1 and Fig 1, A and B).

Bacon summarizes his treatment as follows: Avoid all manipulations. Place patient in bed in the position most favorable for comfort, let patient alone, in 3 weeks begin passive movement, massage, and faradic current. But his 31 patients show rather unsatisfactory end-results (Table I).

Sever reported 51 cases. He describes the majority of his cases as having been treated in bed or in Bradford frame with a swathe. Plaster of Paris and traction seem not to have been employed except in 1 or 2 cases. The results in his cases are shown in Table II.



Fig. 1. Dr. Roe's technique. Fig. 2. Dr. Nelson's procedure. The patient is in the supine position.

See Fig. 1. The description of the method employed by Putt is as follows: A tract is employed. Putt drives a pin into the greater trochanter in a line with the shaft of the femur, then applies a cast and using the cast as a base for a metal loop, a spring makes a pull upon the pin in line with the neck of the femur so as to pull the head out through the fracture opening. This is about as Whitman (17) has done. The greater trochanter as a lever and as the writer does by acetabular traction and abduction (see Fig. 6 A and B). It is necessary that such traction be maintained.

The plaster of Paris device shown by McNealy and Willems consists of a double space extending from the crest of the ilium down to just above the knee, in order to immobilize the fracture area, to relieve muscular spasm and pain, or to permit attendants to turn or move the patient comfortably. Moreover it seems absurd to allow the extremity attached by ligaments to the fragments of a fractured pelvis to be moving by knee flexion and by the rotation caused by a feeble struggling leg from the hip socket. But even an inadequate plaster of Paris cast superior to the unaided eight-and-a-half pulley

traction and lateral pull devices still commonly advocated in the literature (Palmer, Cotton, Wilson and Cochran and others). In the 3 cases reported by Palmer, for example, all had some limp and disability.

It is not enough to save the lives of these patients. Caldwell, who describes his treatment with sandbag, Buck's extension and attempts to reduce fragments through the vagina or the rectum (a mode of attack which seems inadequate) says: "In women who expect to bear children the deformity must be corrected if it is humanly possible to do so." It has been our observation that for such severe injuries as these appear to be the mortality rate is very low. We must devote ourselves more assiduously to the prevention of limp and disability in any condition of this sort and in women especially to the protection of potential mothers against deformities of the pelvis at birth can.

Our criticism of prevailing methods proceeds from the premise that treatment should seek to

TABLE II.—RESULTS IN DR. SEVER'S FIFTY ONE CASES

Result	Fracture			P
	Il	Pub	Acetabulum	
Good	3	6	5	47
Fair	3			
Died				
Unknown	3	8	3	3

TABLE I.—RESULTS IN DR. BACON'S THIRTY ONE CASES

	Age	Sex
Good	4	45
Fair		4
Left foot disabled	1	
Died	5	
Unknown	1	

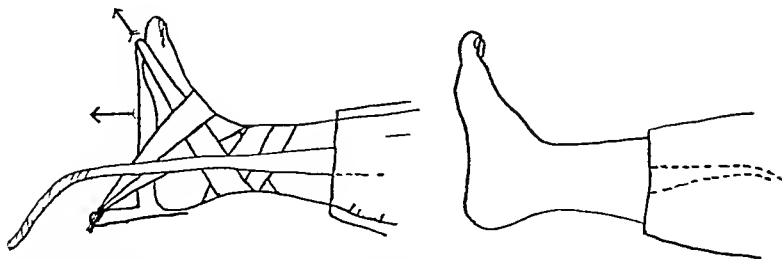


Fig 2 Direction of traction during application of first part of cast

Fig 3 First part of cast finished Traction plaster turned back and locked in the cast Foot in position for application of final portion of the cast

establish (a) restoration of the damaged parts to their proper anatomical relationships, (b) rest, as the most important therapeutic measure, and, (c) in the presence of infection, adequate drainage with protection of the wound against new or further infection. The older procedures seem to neglect the fracture in order to treat the wound, or to deal with intrapelvic complications, or to await spontaneous recovery from shock. Or they effect what seems to be a compromise, allowing for some wound treatment and partial immobilization of the fractured parts. Or else, having the right objectives, they fall short in the mechanics of making them effective.

The technique employed by the writer has involved an entirely different approach to the patient with a compound pelvic fracture. If the patient is in shock and especially if there is an intrapelvic or peritoneal injury, it is considered that the first indication is to restore the injured parts, both bony and soft parts, to as nearly normal relationship as possible. That is to say, along with whatever wound or intrapelvic surgical treatment is necessary, an effort is made at once to reduce the fracture and to immobilize all of the injured parts in the best relationship obtainable.

Instead of employing hammocks and binders or adhesive strapping about the pelvis as has been customary, it is the practice of the writer to place the patient upon a fracture table and by making use of the lower extremities and their attachments to the pelvis, perform such traction and manipulations as are essential to restore the extremities, the pelvis, and the trunk to correct relationship to each other (Figs 2, 3, 4, and 5). This usually has the effect of "setting" the fracture at once. A moderate amount of abduction and traction of the lower extremities and support under the sacrum or lumbar spine when necessary will usually restore the bony portions of the pelvis no matter how badly fractured and displaced, to a near semblance of normal relationship.

If a reduction of the fracture can be carried out soon after the injury it will often be found that shock will be prevented or that the patient will come out of shock on the operating table before anything further is done. This is for the reason that all of the parts, including the nerves, blood vessels, and other structures as well as the bony parts, are restored to normal position, and nerve impulses and circulation begin to function at once in a more nearly normal manner.

Of great importance is the maintenance of correct length by a pull upon the foot. Hence, adhesive plaster, ice-tongs, or pins which are to fix the extremities (and the pelvis indirectly), by inclusion in the cast, are all held in exact position during the application and setting of the plaster-of-Paris bandages (Figs 2, 3, 4, and 5). When any or all of these devices have been secured in the cast, the foot bandages may be released and the feet included (see Figs 2 and 3). In this way the traction is truly "fixed traction"—begun on the fracture table and continued in the cast—and there is no pull or pressure later on the dorsum of the foot or upon the heel in the back. When it is desired to obtain additional security against muscle spasm in the lower trunk, hips, or thighs, heavy weights may be hung upon the crossbar of the cast with the foot of the bed raised. When applied in the manner described above, the cast cannot slip down against the foot (Fig 5).

If there is a large open wound it is treated by the author's method of debridement, petrolatum pack, and closed cast so that there is no occasion for frequent dressings, windows in the cast, or disturbance of the wound or the position of the patient. This is true also when there is an old osteomyelitis. In all such cases special attention must be paid to determining the exact location of the infected area and to the provision of adequate drainage. Quite often an abscess cavity, or even a sequestrum may lie on the inner side of the pelvis between a thickened ilium and the peritoneum.



Fig 4 Application of dressing
Fig 5 Patient bed tilted at 30°

Recently I had such a case with the abscess cavity occupying at least one third of the entire inner surface of the ilium. In this case a large sequestrum lay at the most dependent portion of the cavity and from there a sinus extended downward to drain on the outer surface of the thigh below the great trochanter. In this case (as I consider necessary in such cases) about one third of the ilium from the crest downward (Fig 7) was removed so that the whole bony roof of the abscess cavity was taken off the wound treated by the Orr method and rapid improvement resulted. The sinus draining downward through the thigh was healed at the first dressing and the large wound over the ilium practically healed at the second dressing. For those unfamiliar with the method the exact technique employed in this case which is essentially the same in all cases of osteomyelitis regardless of pathology or type of infection is described.

The patient was placed upon the traction table with moderate active traction and abduction to correct the contracture of firmity which was present. The skin was prepared with tincture of iodine.

1. An incision was made from about the middle of the crest of the ilium forward and downward. Then all the soft structures were removed down and back until the sinus opening into and through the ilium were exposed. Exploration over the crest added down over the inner surface of the ilium revealed the extent of the abscess cavity. The sequestrum, a large portion of the ilium, was cut out from the crest downward and the cavity exposed (Fig 7).

3. No more the entire cavity was gently packed out with iodine and alcohol and packed widely open

with petrolatum gauze covered by a firm gauze pad.

4. One of the large firm gauze pads with the patient moved the patient either during the operation or after a double plaster of Paris cast was put on. Mole skin adhesive traction traps the full length of both legs were pulled down and turned back at the ankles to the cast as it was put on (Figs 2 and 3). This method gives fixed traction on the cast and controls rotation of the legs as well. It draws away entirely with muscle spasm and loss of position after operation. In fact, it acts against the condyles of the femur as used on the malleoli or pins through the bony parts if necessary.

5. Finally, no dressing as done in this case until the sixth week. The second dressing as done at the fifteenth week. The patient was practically healed and his general condition had improved very greatly.

The postoperative course of such a patient becomes tremendously simple. He can be moved in any position on either side or on the face as desired and without disturbing the injured patient. However, the patient in any manner if the surgical complications in the abdomen sufficient to put the cast may be removed to expose the area upon which a surgical procedure may be necessary.

Surgical exploration of the pelvis either supra-pubically or perineally may be done with perfect facility and without compromise to safety and comfort for the patient if he is a well cast plaster of Paris cast. It is a common opinion that immobilization should always be continued in order to hasten the chances of recovery as with these patients have been found to be better results from immobilization and to



Fig 6 A and B Tracings from X ray films show effect of the abduction traction manipulation upon a 12 weeks old central fracture dislocation of the head of the femur and the pelvis The patient made a good recovery

improve more rapidly if they are thus protected against irritative motion, muscle spasm, and disturbances of the injured parts

We have so frequently been called upon to defend the surgical wisdom of these procedures that we like to hark back to fundamentals in discussing them Far from being radical or unsound, they appear to us to follow the oldest of surgical precedents The whole program of treatment is directed toward first restoring the injured organism to normal anatomical and physiological relationships, and then providing a regimen which, on the one hand, provides a maximum of rest and comfort during the healing process, and, on the other hand, offers protection against further complications or disturbances and a minimum interference with the innate restorative powers of the body

In a consecutive series of fracture of the pelvis in the practice of my associate Dr Thomson and myself, and in which the methods described have been regularly employed, we have obtained the results shown in Table III Three selected cases are given to illustrate methods and end-results

CASE I H A T, male aged 28 years was injured on September 2, 1931, in an automobile accident He was brought to the hospital by aeroplane on the third day and was found to have a very severe deformity of the pelvis The upward displacement of the left ilium on the sacrum was one of the serious elements in the deformity (Fig 1, A and B, compare with Fig 8) At the time of entering the hospital the man was still in shock and delirious There had been some vomiting and intra abdominal disturbance His general condition was so poor that an accurate diagnosis of his condition could hardly be made He was placed at once upon the operating table and with strong traction and abduction the parts were brought into nearly normal relationship Two weeks later, because of the fact that the

left ilium was still somewhat high with reference to the pelvis, additional traction was made upon the left lower extremity which had been included in the cast with moleskin adhesive traction fixed in the plaster Following this second manipulation the position was as shown in Figure 1, B He made excellent progress and left the hospital at the end of 8 weeks He was walking well at the end of 10 weeks and has continued to improve so that at the present time he is almost normal This patient was a striking illustration

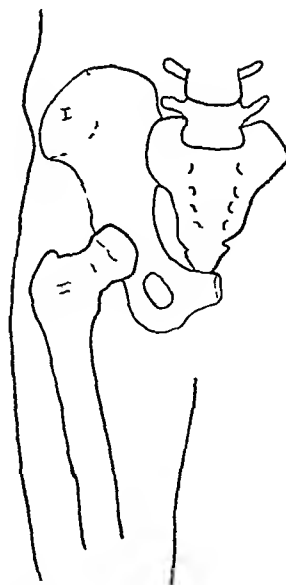


Fig 7 I Typical bone window to be made in the ilium in cases in which there has been compound fracture or osteomyelitis with abscess formation on the inner side of the pelvis II, Typical bone window for acute osteomyelitis at the upper end of the femur Such windows should be made subperiosteally

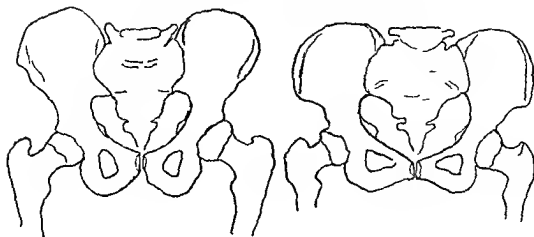


Fig 8 I l t m l p l g h t (m l p l) (After T l d t)

f th f f c t f d a l t t m t t h g h h a s h
 p o o d t p r r y l t t h e p l l h f a c t
 f g m n t e a l l i n r y b d p o t h h k d
 d l i n d h d h u g h t m p t i n s p t f t h h
 p l d t c p t h p a t a n g t b l d t h e u a l
 p o c e d s t d t f f t d p p l c a t f
 a s t i n e c t p t r e a n d t C d g h i
 d t h m p m n t r a p d A f t t h t h d
 f t h y h m p d t a d u l y a d w h i l h i s p g r w a s
 l w t h t h m a d m p l t a d s a t i s f i r y e c r y
 C x L R m l g d o r s b g h t t h
 O r t h p e d l i p t a l M r c h o s t h t e
 a c b u n f a l d t o o m y l t s f t h r i g h t u l m h
 h a d h a d f p p i d r i n g t h p e d g s
 y r a H w t a k t t h p t u n g o o m a n d t h
 r i g h t u l u m p s e d b y n c a l g t h t h s o f t
 s t r u t e s b g e f f e c t e d d n d d b k w a d
 p e s o t e a l l y t d t h e h i p t A l g w f d
 p t t u n g t h u l m t o t h e i n d A s e c t f t h
 l m m d d e a t e d i n F g u 7 d a n b e c a s
 b t l g s g g w f d i l y g h t t h a n
 a d f t h u l m a n d t h p r i t m T h w
 s e q t r u m i n t h c a s e l f i t m t f l u m w s
 m e d t e x p s e t h b a c c a l y T h n d w
 p l d p t h a s e l g u z d d b l p l a s t e r f
 p p p l d T h s l y y m p t m s d a t t
 b a d a s t h y d i n r i l y d f l l a n g t h p a t h
 c o t u d t h h u g h t m p e t t h m p t m s f
 h a l f e c t U p t h g t r e q t i s o m

f t h f d s f t h p t s t a n d f t h d o c t h d
 w a s p e d p d t h a s e l p k a s d l i
 t h t t h d f t h d b e e n f d t t h a s e p a c k
 m g h t b e a c t p l g d p r e t g h s c p f i d s
 h g f m t h d T h n i h s f u r d
 t b e i n g o o d d t t a s p l d t h a s e t
 t h d e s i n g p p l d d t d t d
 f t h f s o m w l l t a s t t l 3 e c b o
 t h t h b y a c u t n l t y m p t s o d
 F l o a n g t t t i m t h y m p t m l d p p r y b e
 m a d r y d t h w d s o u n d y h e a l e d i n 3
 m t h s T h s a a t h f i t t i m t h h a d b e h a l i n g i n
 m t h s j r s S u n t h h a s a n a n e p u c a l l y
 H A l t h g h t h b s o m e l l g n f l l g
 a n d r u t t w o c a s o h h h d g e n e r a l
 y m p t m f i n f e c t s e p t c e m a T h u s o d e
 f m t y a d t h u l p p t l y b e p e m t d u
 h l t y l f c h b e w g c t d p t f p
 t e o n

C x 3 k O f m a l e g o d 8 j r s t a n d s e r e
 c o m p o d f a c t u r o f t h r i g h t u l m F b r u y 3 j
 f d d t s e b e u n t i l t h f t h l y T h e t
 o p n a g t h c r t o f t h u l u m f t d m l p l
 f a c t w t h t a t p p e t h d f t h l b r o k f
 l r u n n i n g f m t h t a u t p l f a c t e m f t t t h
 s a o a j u n t t t h b a c k l a d d t t o t h f a c t o f
 t h u m a s h a d f t e s f b t h l l f t f h
 g h t h m r u w t h m o d t r u h g d t h r e e t a l
 f r a t u r e s i n t h u p p e r p o o d m a s g e a t p a n
 g r a l d t a s r y p o o d m a s g e a t p a n
 d d r t N t e m p t h d b e e m a d t h t m t
 d y f t h f a c t S h w a s t t t h o p e r i n
 o m t a n d l l f t h f t e s e d a s f l a s
 p o a b l e S h e w a s p l a c d p l t o f p r a s t b u c h
 t d e d f o n t h t p s f t h f i n g t h g h t a r m t t
 t h t f t T h l u n p g t h l u m
 a l g e d d t t c a t y p a c k e d t h s e l i n e g a u s e
 A p a s e d t f t t l e i n g p e r f t h e f a c t u r l
 u l m p o t u n N t e c h d a n g t b e a s e d
 T h g h t r u n d b o t h l g c h e d g o o d l e g h
 a n d p t i b y m l u n a d h e s t a c t f m t u e a l i n
 d w i t h t h d i d d t h a s t (F g s a n d 3)
 S b e e g t h y p u m w a l s o u s e d t h u s t h u m e r u
 I n f e q t d s s i g w r d t h e p e l w a d a n d
 t h a s o d i l y h a l e d a t t h e d f w k h a b e

TABLE III—RESULTS IN FRACTURE OF PELVIS

Res lts	P b u c l m	l	Both a n p u b	S r u n	C a s e	P
Good	25	7	6		39	86.6
Poo	3				5	
Ded						
U k w n						
T t a l	9	9	6		45	100

left the hospital. During the third week she had an interesting and severe complication—a phlebitis involving the left shoulder and arm. This was the only extremity we had not immobilized up to this time. Upon the onset of the phlebitis the left arm down to the hand was also included in the cast. The phlebitis subsided in the course of a few days and gave no further trouble. The clavicles healed in good position without deformity or disability. The right humerus was slow in healing, but is now solidly united; the only disability remaining is a limitation of extension of the elbow, which she can extend to within 20 or 25 degrees of normal. The compound fracture of the pelvis was soundly healed in 8 to 10 weeks with no remaining disability or deformity whatever although there is a moderate defect at the point where some of the bone fragments had to be removed and there is a fairly large scar.

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PRIMARY BENIGN TUMORS OF THE URETER

REVIEW OF LITERATURE AND REPORT OF 1 CASE

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1 m b S. 1 C. N. Y. L. C.

PRIMARY benign neoplasm of the ureter is a rare lesion which is not easily nor frequently diagnosed clinically. Recently such a condition was found in a patient of Dr. George W. F. Sh and operated upon by him in the Squier Urological Clinic. His symptoms were due to large calculus which obstructed the lower left ureter and caused a pyelonephrosis. We feel that the lesion is of sufficient rarity and interest to justify a report of it and a review of the literature.

Primary neoplasms of the ureter are divided into benign and malignant groups of which the former are less commonly observed. Excellent reports and reviews of primary ureteral malignancies have recently been made by Kretschmer, Playe, Rousselot and Lamon and others. The case here reported is microscopically benign so only this group will be considered. Reviews of benign tumors primary in the ureter have been made by Spess, Culver and Aschner, Rousselot and Lamon, reported 50 cases of malignant primary ureteral tumors in 1929. In 1922 Aschner was able to collect only 21 cases of benign primary ureteral tumors, one of which (Rayer's) we, with Rousselot and Lamon, believe to be malignant.

The case here reported is that of a 27 year old Irish American who was admitted to the Squier Urological Clinic (No. 273-65) October 7, 1930 and discharged November 6, 1930.

For the past year he had occasional flanks aches, rare less than which is not easily nor frequently diagnosed clinically. Recently such a condition was found in a patient of Dr. George W. F. Sh and operated upon by him in the Squier Urological Clinic. His symptoms were due to large calculus which obstructed the lower left ureter and caused a pyelonephrosis. We feel that the lesion is of sufficient rarity and interest to justify a report of it and a review of the literature.

Primary benign neoplasm of the ureter is a rare lesion which is not easily nor frequently diagnosed clinically. Recently such a condition was found in a patient of Dr. George W. F. Sh and operated upon by him in the Squier Urological Clinic. His symptoms were due to large calculus which obstructed the lower left ureter and caused a pyelonephrosis. We feel that the lesion is of sufficient rarity and interest to justify a report of it and a review of the literature.



Fig 1 Pyelogram showing a normal right kidney and an enlarged left kidney with calculi in the lower calyces. The two large calculi are evident in the left pelvis

Fig 2 Film 15 minutes after injection of uroselectan showing kidneys, pelvis and upper ureters. The bladder partly filled and two pelvic calculi are seen outside of it

except for a very small amount in the left ureter, thus showing that the left kidney pelvis did eventually empty.

The uroselectan series furnished much valuable information. First, it confirmed the pyelographic findings of an apparently normal right kidney and ureter. The location of the two large, low, left calculi was definitely shown to be within the ureter and not in the bladder. The pronounced dilatation of the left calyces, pelvis, and ureter confirmed our suspicion of irreparable damage. Finally, the stricture at the left ureteropelvic junction was demonstrated. Since a pyelogram could not be done on the left side because of the obstructing calculi, these findings were possible only by means of intravenous urography. They were sufficient indication for surgery.

On October 22, 1930, 5 days after admission a complete left nephro ureterectomy was performed by Dr. George W. Fish. The pre operative diagnosis was left ureteral and renal calculi, left pyonephrosis, and left hydro ureter.

A left lumbar incision was made, the kidney exposed, and the ureter isolated and freed down to the calculi in its distal end. The ureter was clamped above these large calculi, cut across, and the calculi extracted. With the calculi removed, the ureter was then tied as low as possible and the excess stump was cut off. The kidney was then delivered, and the pedicle clamped, cut and tied. Two cigarette drains were placed to the ureteral stump, and the wound was closed by separate suture of each muscle layer.

Except for a mild superficial infection the convalescence was uneventful. The sutures and drains were all out by the eleventh day and the patient was discharged home on November 10, his nineteenth postoperative day, with a small, granulating wound.

The pathologist gave us a detailed description of the specimen (No. 915) of which Figure 6 is a pen and ink drawing. Macroscopic. The specimen consists of a rather large congested kidney with adherent fatty capsule. The kidney weighs 275 grams and measures 14 by 9 by 6 centimeters. The pelvis is dilated and an increase in the peripelvic fat is noted. Thirteen centimeters of ureter are present. Near the ureteropelvic junction, a marked narrowing is seen, while below it the ureter gradually becomes fusiform and at its distal end is distinctly dilated. The ureter is cut lengthwise, and the distal circumference is found to measure 3 centimeters, while at the stricture the circumference is only 0.75 centimeter. Hanging downward from the stenosed area in the lumen of the channel, is a pedunculated and elongated wormy mass, measuring 4 centimeters in length. The tumor is narrowest at its origin where it measures 0.2 centimeter, and widest near its distal end where it measures 0.7 centimeter across. Immediately above the stricture, and completing the closure of the channel is a small calculus. Above is the dilated pelvis of the kidney from which urine under tension burst forth when opened. The mucosa is congested and the seat of multiple petechial hemorrhages. The kidney was opened in retrograde fashion from the pelvis, and revealed dilated calyces some of which contained calculi. In one there were five small stones floating in a brownish, grayish pus, and in another there were two calculi. The cortex of the kidney is narrow. Two large, gray, somewhat faceted calculi, said to have come from the distal end of the ureter are present. They each measure 2.0 by 2.0 by 1.5 centimeters and each weighs about 50 grams.

Microscopic. Sections made of the distal portion of the tumor reveal that it is made up almost entirely of fibrous



Fig 3. KUB taken 45 minutes after ingestion of contrast medium. The dilated ureter is visible as a long, thin, radiopaque structure extending from the upper abdomen down towards the bladder. The bladder is also visible as a large, rounded, radiopaque structure in the lower abdomen. The surrounding soft tissue and bowel loops are less distinct.

This case presented several rather unusual features. One does not often encounter such large ureteral calculi as were caused by the X-ray and found at operation. They measured 2.0 by 2.0 by 1.5 centimeters and because of their size shape

color and faceted surfaces resembled gall stones more closely than ureteral calculi. These calculi must have been in the lower ureter for the very long time or else have had a recent very rapid increase in size. The firm lead structure of the upper ureter was so narrow that it prohibited the passage of a calculus the size of a small pea which was found resting above it.

The marked dilatation of the ureter for its entire length is certainly not common. While the stricture at its upper end with a calculus caught above and a polyp suspended below add to its unusualness. The pyonephrosis and the numerous renal calculi probably resulted from the obstruction.

The presence of the polyp was not suspected until the ureter was opened by the pathologist. The uroselectan and plain X-ray films were reviewed but no shadows were detected. It might have suggested the presence of the polyp. The marked dilatation of the ureter, the inability to pass a catheter beyond the large obstructing calculus and the absence of any hematoma could make a diagnosis of this condition very unlikely. At operation the stricture and calculus above it but not the soft polyp were felt.

The presence of the stricture polyp and calculus leads one to speculate as to which was the primary etiological factor. A logical explanation seems to be that one or more calculi set up an irritation of the mucosa of the ureter at one of the points where it is normally narrowed: the ureteropelvic junction. This initial irritation was apparently sufficient to produce the resulting stricture. The polyp, which microscopically resembles scar tissue, may well be simply a local overgrowth of the stricture resulting from the constant stimulation of an overlying calculus. The large calculus in the lower ureter probably passed through the stricture and down the ureter when they were much smaller because their large deeply faceted surfaces indicated intimate contact for a considerable part of their development. We regard the early calculus as the primary offender.

The tabulated data (Table I) is of the reported cases of primary benign ureteral tumors. Much evidence has been able to find after a careful review of the literature. Most of the diagnoses are based on a microscopic report though some of the earlier ones are dependent on a gross examination only. We have included 5 of the 7 cases reported by Culver⁹² and an additional 6 from Aschner's report of the following year. We have excluded Rayer's case which was undoubtedly a carcinoma because of the extensive metastases it describes and Jonas which was reported as an epithelioma.



Fig 4 Film taken 75 minutes after injection of uroselectan showing the right pelvis nearly empty. The left pelvis and ureter have not emptied because of the obstructing calculi.



Fig 5 Film taken 6 hours after injection showing both kidneys, the psoas muscles, and the left renal and ureteral calculi. The left lower ureter shows a small amount of dye but the left pelvis is empty.

To this number we have added 7, those of Takahashi, Huc, Beer, Kleinschmidt, Walker, Loeffler, Mayer, and the one here reported.

Though the group is small and the lesion is rare, a statistical study proves interesting. The age of the patients at the time of diagnosis in the 25 cases in which age is mentioned, varies from 24 to 78 years, with an average of 51 years. It is, therefore, a disease occurring past middle age. Of the 27 cases in which sex is mentioned, 11 are females and 16 males. The lesion occurred 9 times on the left and 15 times on the right and is not designated in 5 cases. In 14 cases the tumor was in the lower ureter, in 9 cases in the upper ureter, in 4 cases in both locations, and in 2 cases not designated.

The longest duration of symptoms was 10 years, the shortest 1 day, with an average of 2 years and 10 months. Hæmaturia was noticed by 17, tumor was palpated in 11, and pain was complained of by 10 cases. All three complaints were registered by 3 patients and 2 complaints by 9 patients.

SYMPTOMS AND DIAGNOSIS

The three outstanding and almost the only symptoms of ureteral tumor are pain, hæmaturia,

and a palpably enlarged kidney. None of these, however, is in the least pathognomonic.

The hæmaturia is usually intermittent, often profuse, and frequently can be elicited by trauma from a ureteral catheter. The blood is intimately mixed with the urine, but worm-like clots, which are casts of the ureter, may be passed. Hofmann's patient died from hæmorrhage from a bean-sized ureteral tumor.

The pain which is complained of may be of two types. The passage of small clots gives an acute colic simulating that caused by small calculi, and is present only during or immediately following a period of bleeding. The constant, full, heavy, dull aching in the costovertebral angle is the pain caused by the progressive hydronephrosis. The severe, constant, penetrating pain of an infiltrating carcinoma is not encountered in these benign lesions.

Though Quinby reported a case of a malignant ureteral tumor which could be palpated abdominally at the pelvic brim, we find no record of a benign tumor which could be so felt. The palpable tumor which is made out is invariably a hydronephrotic kidney.

The diagnosis of any ureteral tumor is a difficult task. In their series of 50 malignant ureteral



Fig 6 D g f g pec m a h w g t h m k d
d lat t i th k i d n y l y e s p f s d t The
t r i c t t t h i p l j t b a t h e t m
p d d f m t C l l d t t h l y d
b o t h t t T h t l g l h b e e d m
a n t h p p u n t p s u t t h y o c p e d m t h l
t

tumors Roussel t and Lamou fou d that 3 per
ent were u p e c t e d r e d e f i n i t e l y d i a g n o s e d b e f o r e
operation I n t h e s e r i e s o f 8 c a s e s 3 6 p e r c e n t
w e r e d i a g n o s e d b e f o r e o p e r a t i o n T h e r e p r e s e n t
t h e 8 c a s e s e e n a d o p e r a t e d u p o n b y H e s c o
A l b a r r a n M a c k n r t h M a r i o n B e e H u c
M a y e a n d K l e s h m d t a n d t h e c a s e s o f L e
D e n t u a n d C l e u p o n w h o m t h e y p e r f o r m e d t h e
s e c o n d o p e r a t i o n I n o o f t h e c a s e s t h e t u m o r
w a s d i s c o v e r e d o n l y a t o p e r a t i o n h i d e 8 w e r e r
p o r t e d b y p a t h o l o g i s t s F i e o f t h e c a s e s h a d a
n e p h r e c t o m y f o l l o w e d b y a u r e t e r c t o m y b e c a u s e
o f t h e p e r s i s t e n t h e m a t r a s p a s s c a s e h a d a
n e p h r o t o m y a n d S u t e r a c y s t o m y n o n i t a l
a t t e m p t t o l a t e t h e s o r e o f b l e d g L e
D e n t u a n d W a l k e p e r f o r m e d t h e o p e r a t i o n i n
t h e i r c a s e s h i l e C u l e r s a s e f f e c t e d t h e m f
t h e s e c o n d p r o c e d u r e



Fig 7 b o L o p o p h t m u g p h f t h d u l
p t i t h e t m i t l a y e i p i b a l m a t t
p t t m i l f i b t h b l l l
Fig 8 H i g h p p l t m a g p h f t h e p a t i a l
p e t i t h t m l i r e v l d e t a t s u g
f g l a n d c r y p t f m a t T l s e f i b u s b e s
h a t f t h p l m d t

W h e t h e d i g n o s i s i s m a d e t u u a l l y d e p e n d s
o n a t l e a s t o n e f t h e p r o c e d u r e s t h e h i s t o r y a n d
g e n e r a l p h y s i c a l e x a m i n a t i o n t h e c y s t o s c o p i c
f i n d i n g s o r t h e x r a y e x a m i n a t i o n

I n t h e h i s t o r i e s o f o u r s e r i e s h e m a t u r a s t h e
c o m m o n e s t a d r o s t d t u b i n g s y m p t o m b i n g
p e e t i n 7 0 p e r c e n t o f t h e c a s e s h u c h s y m p t
o m s r e c o d e d T h e d u r a t i o n o f t h e i n d i v i d u a l
a t t a c k s i s u s u a l l y s h o r t t h o u g h T h o r n t o s e c
b l e d t e m p t e n t l y f o r 9 y a r s B l e e d i n g f r o m t h e
u t e r u s a s f r o m a n y o t h e r s i s v e r y a l a r m i n g
t o a p a t i e n t a n d u u a l l y f o r e s h a t s e e k m e d i c a l
a d d B l e e d g l o m o n e a m i n a t i o n b u t t o d e t e r
m i n e t h e c a u s e a d l o c a t i o n i s s t e n a r a l p r o b
l e m T h e c o m m o n c a u s e s a t f a t s y n f i b

a ureteral or renal calculus which can usually be ruled out or confirmed by careful X-ray pictures with opaque catheters in the ureters. If one can eliminate traumatic injury of the kidney and renal infarction, very few causes of unilateral hæmaturia remain except tuberculosis and neoplasms which often present diagnostic problems. Careful pyelograms and laboratory examination of urine specimens are of real benefit in differentiating them. If, after eliminating these possibilities, one still obtains bloody urine from one ureter, especially after meeting or passing an obstruction with a catheter, he may fairly suspect a ureteral neoplasm. Beer made the diagnosis in his case by producing hæmaturia each time a catheter met an obstruction 7 centimeters from the ureteral orifice. Culver's patient had had a nephrectomy by another surgeon but the hæmaturia persisted and could be produced similarly from an obstruction 23 centimeters up the ureter. Huc likewise produced hæmaturia but was able to pass a catheter beyond the obstruction into the kidney pelvis from which clear urine flowed, thus eliminating the likelihood of a tumor of the kidney. Kleinschmidt, however, obtained bloody urine from the kidney pelvis after passing an obstruction 8 centimeters up the ureter. A unilateral hæmaturia persisting after nephrectomy, as it did in 4 of these cases, strongly indicates the presence of a ureteral tumor.

Pain is a much less frequent symptom and is complained of in only 41 per cent of the cases in which symptoms are reported. The pain is never caused by the tumor itself but is the symptom of some secondary manifestation. The most common discomfort is the dull, lumbar ache resulting from the hydronephrosis which develops as the tumor occludes the ureter. Rarely an acute colic is complained of and is probably due to passage of clots, or rarely, a co-existent calculus, down the ureter.

Upon physical examination, a palpable tumor mass was found on the affected side in 46 per cent of the cases mentioning symptoms. When operated upon, the enlargement was always found to be a hydronephrosis. From our cases, one observes that pain and tumor do not lend much aid in diagnosis.

Cystoscopically, ureteral tumors may be suspected because of a unilateral hæmaturia, or may be definitely diagnosed if observed protruding from the ureteral orifice. Secondary implants of bladder tumors and tumors of the kidney pelvis are frequently seen at or within the ureteral meatus, but it is uncommon to see a pedunculated benign tumor protruding through the orifice. Six of the cases in this series were so diagnosed,

Heresco, Mackenroth, Marion, Albarran, and Mayer diagnosed theirs before operation and Le Dentu his after the primary nephrotomy.

Roentgenological diagnosis of a benign tumor is rare because there is seldom any irregular shadow caused by a constriction of the ureter or protrusion of the tumor as in the malignant lesions. Culver found that the iodide went beyond the obstruction which his catheter met, and showed a protrusion from the ureteral wall. Loeffler made a ureterogram of the pathological specimen in his case and was able to demonstrate a filling defect which he believed could have been shown before operation. However, the tumor is usually so small that it causes no irregularity of the opaque media in those cases in which a pyelogram can be done. Conditions to be differentiated in ureterograms are malignancy, tuberculosis, inflammatory strictures, and calculi. Malignancy, if at all advanced, will give an irregular deformity and narrowing of the lumen. Tuberculous destruction of the ureter would almost certainly be associated with changes in the kidney and bacilli in the urine. Strictures of the ureter are now more easily diagnosed by means of intravenous dye, the effectiveness of which does not depend on forcing a catheter past the obstruction.

In our case, the stricture at the ureteropelvic junction showed clearly in the uroselectan films but neither the calculus immediately above the stricture nor the polyp suspended from its border gave any indication of their presence in the X-ray films.

TREATMENT

When diagnosed, the ideal treatment of ureteral neoplasms is their complete removal, which is undertaken by various surgical procedures. Table II shows the methods employed by different surgeons.

Fulguration through a cystoscope of a tumor seen protruding from the ureteral orifice is probably the least mutilating procedure. However, one can never be certain of the diagnosis or of the complete removal of the tumor except through a failure of a recurrence or metastases to develop. Marion treated a patient twice in this way and was apparently successful since no recurrence was noted.

Takhashi saw a polyp protruding from the right ureter while doing a prostatectomy and simply pulled it down, ligated its base, and cut it off. This apparently cured the patient. Mayer undertook a similar procedure.

Walter did a cystotomy and ureterectomy to remove a tumor, leaving the kidney intact to drain through a permanent urinary fistula.

TABLE I--REPORTED CASES OF PRIMARY BENIGN URETERAL TUMORS

Number and name	D	Sex	Age	Symptoms	Duration	Location	Diagnosis	Co-existing disease	Operation	Pathological report	Remarks
Lebet	86			+++			+			Papillary fibroma	
La tauz	86	F	6	+++	6 mos	+	+	Hidradenoma		Fibroma	
Th	83	F		+++		++		Uteral calculus	A hysteromy		Tumor in upper pelvic region
N. Lee	86	M	1	+		+	+			Fibroma	Doubt ureter with tumor in upper 1/3 per ureter
S. J. b	89	F		+		+	+	Hidradenoma			
S. A. Lman	89	M				++		Dilated pelvis			
Y. B. Lough	89						+	Hydronephrosis			Calculus lodged in ureter
S. P. U.	89	M		+++			+				
Le Den	89	M		+++	5 yr	+	+	Hidradenoma Uteral calculus	() Nerve to () in broad	Vascular fibrosarcoma	Tumor seen by microscope after 12 per cent ureteral dilatation
Herscov	90	M		+	Y	+	+		() Transverse calculus with at least 1/2 of ductary at hysterectomy lot about 12 cm	Adenopapilloma	
Albar	90	F	6	+	Y	+	+	Dilated left ureter	Transverse at m. al with in dilatation of ureter	Adenopapilloma	
M	90	M		+		+	+	Hidradenoma	Hysterectomy	Vascular fibrosarcoma	Nephrectomy did not show tumor. Tumor found
M. C. K. W.	90	F	18	+++	6 mos	+	+		Transverse at 1/2 of ureter		
Walter	90	M	8			+	+		Cystotomy and m.		Ureter moved and placed permanently urinary to side.
Brub	90	F	60	+	mos	++			Transverse at 1/2 of ureter		
S. S. L.		M	6	+	6 mos	++			() Cystotomy () at hysterectomy () ureter tumor		Ureter cured after peritoneum
Fracton		F	6	+		+		1.5 cm benign Calculus			
S. S. W.		M	5	+	6 mos	++			() Nephrectomy () at hysterectomy	Basal mixed pedunculated tumor vascular fibroma	Ureter cured after peritoneum

TABLE I—Continued

Number and name	Date	Sex	Age	Symptoms Hematuria Pain Tumor	Dura- tion	Loca- tion Left Right	Diag- nosis Operation Cystoscopy Autopsy	Co-existing disease	Operation	Pathological report	Remarks
19 Hotmann	1916	M	60	++		+	+		(1) Nephrectomy, (2) cystotomy		Patient died from hemorrhage from a bean-sized ureteral tumor found at autopsy
20 Marion	1919	F	66	+			+		Fulgurated twice		Tumor at ureteral orifice fulgurated. Hematuria persisted and a second tumor found 5 cm. up ureter was fulgurated. Cured
21 Culver	1921	F	35	++	2 yrs	+	+		(1) Nephrectomy (2) ureterectomy	Vascular epithelial polyp	Hematuria persisted after nephrectomy. Ureterogram showed opaque media beyond obstruction to catheter
22 Walker	1921	M	64	+	4 yrs	+	+		(1) Nephrectomy (2) ureterectomy 3 months later	Simple villous papilloma	
23 Beer	1921	M	61	+	1 yr	+	+	Hypertrophy of prostate Hydronephrosis	Nephro-ureterectomy	Hazelnut-sized tumor 7 cm. up ureter Papilloma	Induced bleeding from ureter by forcing catheter against obstruction
4 Hue	1924	F	44	++	2 yrs	+	—		Nephro-ureterectomy	Pea-sized pedunculated polyp 12 cm. up ureter. Papilloma	Passed catheter beyond bleeding obstruction and obtained clear urine.
25 Loeffler	1925	M	24	+	1 day	+	+	Stricture of ureter	Nephro-ureterectomy	Tumor 6 by 1.5 cm. 7 cm. below kidney pelvis. Papilloma	At operation felt tumor 2 cm. below stricture. Ureterogram on specimen showed filling defect caused by tumor
6 Kleinschmidt	1925	M	62	+	1 yr	+	+		Nephro-ureterectomy	Walnut-sized, pedunculated tumor 8 cm. up ureter. Fibro-epithelioma	Catheter met obstruction 8 cm. up right ureter and passed beyond it to find bloody urine in pelvis.
27 Takhashu	1928	M	64	None		—	+	Hypertrophy of prostate	Excision	Tumor 3 by 0.8 cm. Papilloma	While doing prostatectomy tumor was seen protruding from ureteral orifice pulled down and cut off.
28 Mayer	1928	F	21	Hematuria	3 mos	+	+		Cystostomy with excision of tumor	Tumor 1.5 by 0.4 cm. Loose, oedematous connective tissue. Fibroma	At cystostomy tumor was seen to move in and out of ureter with peristalsis. At operation tumor was pulled down ligated and excised.

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TABLE II—TYPES OF OPERATIONS REPORTED

	C	sc
Fulgur t (Marr)		
L t and cist (T kh hi M y)		
U t ect my (Walt)		
Exciso d implantat f t int bl dd		
(M ck nr th Bru et Alb H sc)	4	
N ph ct my (Th into Muzi H fman)	3	
N ph e tomy f ll w d by t ect my (L De t		
S t Sp s Cul Walk)	5	
Primary phro-u t ect my (B H Kl m		
schmidt L effl)	4	

Tumors of the extreme lower end of the ureter have been successfully treated by excision of a portion of the ureter and bladder containing the tumor and implantation of the ureter into the bladder Mackenroth Brunet Albarran and Heresco each carried out this procedure Although Heresco had to do a secondary nephrectomy because of a badly infected kidney the patient recovered in each case

Primary nephrectomies were done on 7 cases with but 1 satisfactory result Thornton removed a tumor which happened to be at the ureteropelvic junction Muto and Hofmann who did nephrectomies for bromatuna both report postoperative deaths the latter from hemorrhage from the ureteral tumor Suter Spiess Culver and Walker each resorted secondarily to a ureterectomy for a cure

The most extensive and most shocking operation and yet the one that probably offers the patient the greatest measure of safety is a complete nephro-ureterectomy which was performed in 9 of the cases of this series The extent of the tumor is seldom known before operation or even at operation so excision of a lower ureteral tumor may leave untreated tumors in the upper ureter or renal pelvis If the tumor which is removed proves microscopically to be malignant any cautious surgeon would certainly want to remove the kidney and remaining ureter because of the extreme likelihood of there being a primary tumor there In only 4 of these cases was this procedure undertaken as a primary operation those of Beer Huc Kleinschmidt and Loeffler Le Dentu performed a nephrotomy on his patient and later a nephro-ureterectomy Suter did successively a cystostomy a nephrectomy and a ureterectomy Spiess did a nephrotomy a nephrectomy and a ureterectomy Culver and Walker did ureterectomies on patients previously subjected to nephrectomies All of these report recoveries and cures in spite of the extensiveness of the operation

Though only 4 of the 18 operative cases in this series underwent this operation as a primary pro-

cedure 5 additional ones ultimately had the same work done in several stages No operative mortality is reported among the cases so treated We believe that if a tumor of the ureter can be definitely diagnosed and the opposite kidney is functioning satisfactorily a primary nephro-ureterectomy is the operation of choice

SUMMARY

There has been reported in detail a case of primary benign ureteral neoplasm accompanied by a stricture of the ureter ureteral and renal calculi and marked dilatation and infection of the kidney pelvis and ureter This combination of lesions has never before been reported

The literature has been carefully reviewed The various types of treatment undertaken have been described and their results evaluated While of little real significance a statistical study of this series is presented

CONCLUSIONS

From our study of these cases we have concluded that primary benign ureteral tumors are rare lesions which are infrequently diagnosed The treatment which is safest for the patient and offers him the best chance for a cure is primary nephro-ureterectomy

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logical laboratory, and also in the bacteriological laboratory for culture. Rosenow in the bacteriological laboratory secured from them a type of diplococcus, which evidently, by chemical stimulation, caused hyperplastic growth. It is possible that the origin of this type of bacteria was the cervix even though the firmus tissue of the cervix does not lend itself to local growth except in inflammatory processes and in these conditions growth occurs only in mild degree.

Within the last few years, attention has been called to certain infectious diseases of the cervical canal processes which are situated in the small glands in and around the mucous lining of the canal and in the larger glands around the cervical opening which have become cystic and which contain mucoid or mucopurulent material. Such infections are constantly found, especially in cases of rheumatic involvement of small joints in women, and in cases of ocular disease, such as chronic recurring iritis, inflammation of the ciliary body, and pterygium keratitis, which appear first in one eye and then in the other, often greatly injuring the sight. Identical conditions are found in men, the infected prostate gland furnishing the bacteria which localize in distant parts. Unless the genital tract, both of the male and the female, is included in the search for foci of infection, the investigation has not been thorough.

Coring out the cervical canal with an electric cautery, removing all of the mucous tissue up to the internal os, cures many of these patients. Selecting a part of the tissue which has not been too severely heated, to grind up for a culture and injecting the culture into the veins of rabbits frequently will reproduce the secondary disease, making a spectacular demonstration of the effect of the organism. To hasten recovery in advanced cases of disease caused by focal infection, a vaccine made from the cultured bacteria will greatly favor resolution of the inflammatory zone. It is rare that the causative organism is found free in the cervical canal but it might be so found at times following rupture of distended cystic glands. We must remember that it is the absorption from bacteria buried and enclosed in pockets underneath, that causes disease. It is not what escapes but what does not escape and is absorbed that produces secondary lesions. A culture may be positive, but a negative culture is not a certain indication that the cervix is not the focus of infection. An active organism may grow on the first culture and animal injection may prove its specific nature, but a slice of the tissue of the cervical canal often is necessary to obtain definite information.

Rosenow's theory of active localization has been amply substantiated by such men as Biggs and others. Rosenow notes localization and growth in most instances are due to peculiar acquired or inherent properties within the bacteria themselves and to their power to localize actively and that this is a part due to the production of a toxin or poison which affects specifically the tissues in which localization and growth occur. Bennett, Von Lamm, and Nossal, following Rosenow's methods, found that the organism from the cervix was the cause of certain lesions usually was a slightly diminishing or growing streptococcus, requiring special media and methods of culture for its isolation.

Since the stump of the cervix has so little blood supply following subtotal hysterectomy, making it subject to degeneration, and lowering its resistance to any infection which becomes a focus of infection. In abdominal hysterectomy, amputation often is made at the level of the internal os. Many years ago I realized that it was probably a mistake to save a diseased cervix and I started removing all of the cervical tissue including the canal down to the vagina. The results demonstrated that this procedure minimized the danger of cancer risk. In such operations, one considers the possibility of prolapse of the vagina and the danger of cystitis, with loss of natural support to the uterus, but this complication can be prevented in almost all cases by the uterine ligaments to the cornua of the cervix with a few extra sutures.

This article is not presented in an attempt to discuss subtotal hysterectomy, but rather to review the conditions for and against its employment so far as the cervix is concerned. These are and always will be cases in which subtotal hysterectomy is the most practical from the standpoint of both patient and surgeon.

However, when one dwells on the possibilities of the remaining cervical stump, one cannot but be impressed by the necessity of mastering a technique for total hysterectomy which when properly performed entails a few minutes and a low mortality comparable to the subtotal operation. That such a technique can be developed has been amply demonstrated by members of the staff of The Clinic, especially J. C. Mason. He now employs subtotal hysterectomy in less than 10 per cent of the hysterectomies he performs.

The reason for this change of attitude toward the subtotal operation is justified by the work of others, as well as by experience in The Clinic. The cervical stump should be considered as the guiding factor in the choice of surgical procedure.

CONSIDERATIONS OF SOME INFECTIONS AND DEGENERATIONS OF THE UTERINE CERVIX

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INVESTIGATIVE research has been the stimulus for progress in medicine during the past few years. An ever increasing number of investigators in various countries adds daily to the sum of knowledge. The part played by bacteria as an etiological factor is more and more recognized in acute subacute and chronic diseases. The causative agent and secondarily the resistance of the patient create a more or less specific response. As a result medicine and surgery have advanced by leaps and bounds.

The eradication of existent infection and prophylactic treatment surgical or otherwise of possible infection is the sound basis of future health and happiness. Toward this end in the past 20 years extensive study has been made of the relationship between focal infection and diseases such as rheumatism, the various disturbances which affect the nervous system and those chronic and recurring diseases which affect the eye. Relatively few investigators are engaged in this particular type of research. Physicians are accustomed to prescribe stock preparations of some type in place of autogenous vaccine. One might say the situation requires a certain mental state dependent on gradually acquired technical ability earned through successes and failures; it requires too the opportunity for making repeated examinations augmented by the facilities of a well co-ordinated laboratory.

An enormous number of middle aged persons are dying from circulatory diseases. To what extent are chronic unrecognized foci of infection the cause of this? The patient, his family or his friends are not aware of the patient's illness yet suddenly he falls dead and necropsy reveals the presence of chronic disease of the muscles of the heart, of its blood vessels or the presence of disease of the arteries or veins of the body. It might be said that the death was sudden but the disease was a matter of tedious progress for from 10 to 20 years and because the patient did not suffer pain he did not realize that he was sick. This should be a stimulus toward general examinations on the birthday at least in middle age.

Only a few places in the body are recognized as the sites of focal infection. Diseased tonsils which usually follow diseased teeth, pyorrheal conditions, dead dental pulp and dental root abscesses are common. The roentgenogram reveals

the extent of disease which may not have been noticed by the patient who is being examined with the view of obtaining relief of some acute subacute recurring or chronic disease.

The chronic infective gall bladder especially the papillomatous type is commonly found in cases in which secondary dyspeptic symptoms are present. Chronic conditions of the appendix also are noted and their effects on the sympathetic nervous system causing secondary symptoms referred to the upper part of the abdomen mostly by tightening and spasm of the ring muscles closing the outlet of ducts of one viscus to another.

A patient investigation of papillomatous growths of the epithelium of the mucous membrane makes one realize that these conditions may have a number of causes and that some of these causes may be injury repeated trauma or local infection. Illustrative of this possibly is the single polyp or the generalized polyposis of severe colitis. Such growths may occur in all types of animal or plant cells. Benign tumors are most common in glandular regions like the breast, possibly changing into adenocarcinoma later. Constant efforts at epithelial growth on the margins of ulcers likewise often cause carcinoma to develop. As I have suggested it must not be forgotten that certain types of mild bacterial stimulation also will produce cellular hyperplasia.

The late Erwin F. Smith of Washington D.C. in his investigation of tumors of plant life was able to cause these hyperplastic growths of cells to develop and to predict where they could appear from the hypodermic injection of bacillus tumefaciens in certain plants which were subject to tumor growth and which he had under investigation. Certain insects to protect and care for their eggs and to care for the larvae which are developing quickly cause wonderful hyperplastic plant growths to be produced by applying salivary secretions to the under sides of leaves. Other types of insects apply the secretion to the upper sides of peculiar plant leaves or to the stems of *Rosa rugosa* causing tumors about 3 centimeters in diameter to grow the cork layer protecting the larvae through the winter.

As to the possibility of bacteria having something to do with the development of uterine fibromyomata for a number of months specimens of small fibromyomata were taken to the patho-

TABLE I—ANALYSIS OF CASES ACCORDING TO AGE, SEX, SIDE INVOLVED, OPERATION, AND MORTALITY

Age in years	Sex			Side Involved			Operation			Deaths	Per cent mortality
	No	Male	Female	Right	Left	Both	Thoracotomy	Rib resection	Not mentioned		
1	13	7	6	10	3		7	6		4	30.7
2	13	9	9	9	9		7	11		4	16.6
3	4	12	12	13	11			22	1	2†	4.1
4	22*	13	9	13	9		2	19		1	4.7
5	10	5	5	7	3		3	7		1	10.0
6	12	7	5	1	10	1		12			
7	8	5	3	2	6		1	1		1	16.6
8	6	3	3	5		1		4			
9	2	2	2	1	1			2			
10	2	1	1	1	1			2			
11	3	2	1	3	1			1			
12	3	1	1	1	1			1			
13	2	1	1	2			1				
Total	123	65	58	63	53	2	25	96	1	12†	9.0

*Includes 1 patient not operated on
†Includes 1 non-operative death

READMISSIONS

Six children who were discharged or released were readmitted within short periods for additional observation because of recurrence of fever. In 2, the fever was due to infections of the middle ear and in a third the temperature dropped to normal soon after the child's admission to the hospital and, after having remained so for 2 weeks, was discharged cured. Two children required secondary thoracotomies and one of these developed a catarrhal jaundice. In only one instance did the disease become chronic. This was a child 7 years old who was originally admitted in March, 1927, and who between that date and December, 1929, had four operations.

ANÆSTHESIA

Of 122 patients on whom operations were performed, 94 or 77 per cent, received local anæsthesia only, novocain solution having been used for this purpose. Eighteen children received ether only and in 6 instances when novocain solution was employed at the outset, a general anæsthetic had to be added to permit completion of the operation. One child received nitrous oxide and oxygen and one other a combination of ether, nitrous oxide, and oxygen. In two records the anæsthetic employed was not mentioned. Twenty-one per cent of the patients, therefore, received some form of general anæsthetic either alone or supplementary to local infiltration with novocain solution. Most of the latter required general anæsthesia because they were too unruly at the time of operation to be handled in any other way. All of the children who died received local anæ-

TABLE II—DISTRIBUTION OF BACTERIAL ORGANISMS AND NUMBER OF DEATHS IN EACH GROUP

Organism	Number	Number of deaths
Pneumococcus type 1	61	2
Pneumococcus type 2	4	1
Pneumococcus type 3	2	
Pneumococcus type 4	16	3
Streptococcus hæmolyticus	19	1
Streptococcus non-hæmolyticus	1	1
Staphylococcus aureus	8	2
Staphylococcus albus	2	
Bacillus influenza	2	
Pneumococcus types 1 and 2	1	
Staphylococcus aureus and streptococcus hæmolyticus	1	
Pneumococcus 1 and staphylococcus aureus	1	
No growth	2	
Not mentioned	3	2
Total	123	12*

*Includes one non-operative death

thesia but these patients were so sick at the time of operation that any other method of anæsthesia would have been contra-indicated. The large group of children who were operated on under local novocain infiltration surely fared better during the first 24 hours after operation. They did not experience the usual postoperative discomforts that follow general anæsthesia. Local infiltration with novocain solution is the choice method of anæsthesia.

OPERATION

In every instance in which signs of active pneumonia could be determined or in which a chest tap revealed a thin purulent fluid, operation was delayed until pneumonic signs had disappeared and until the fluid obtained by repeated aspirations had become decidedly thick and creamy. In no instance were we so encouraged by the results of repeated aspirations to be willing to continue such treatment to the exclusion of surgical intervention.

When placing the child on the operating table or when turning it in bed, care is always taken to move the child so that the unaffected side is always uppermost. To turn the child in the reverse manner may mean the exertion of undue pressure on the mediastinal contents and sudden death from cardiac failure. The one non-operative death discussed above resulted from sudden cardiac embarrassment produced in this way. I saw this child lying in bed apparently comfortable. The patient having noticed that her nurse had left the bedside, turned quickly to call her. Instantly the child began to gasp for air, became cyanotic, and died within a few minutes.

When the welfare of the patient is at stake no effort should be spared to procure and to insure health. With this thought in mind it is possible to judge the cervix from the standpoint of its being a focus of infection.

In China, Japan and the Hawaiian Islands the amount and virulence of carcinoma of the cervix are outstanding. Among the etiological factors the most important seems unquestionably to be poor care or lack of care at confinement and in the postnatal period. Physicians of those countries are handicapped in the field of obstetrics by the large number of midwives into whose hands a vast majority of confinement cases fall.

Either by a process of education or of law it is a great forward step to assure mother and child of proper medical and surgical care. Fortunately Europe in her appreciation of the economic value of manpower is no longer worried by a state of affairs in which maternity cases are neglected. The United States likewise has made rapid strides in hospitalizing obstetric patients.

The cervix then is considered of more vital concern in some countries than in others. For this reason it is not surprising from a statistical standpoint to note wide variations in the development of carcinoma of the cervical stump following subtotal hysterectomy.

It is not my purpose to promote the theory that subtotal hysterectomy by itself is an etiological factor in the development of carcinoma on the remaining stump but rather to emphasize the opinion that the type of operation should receive due consideration based on the history of the patient. Needless to say in the absence of infection of the cervix in a nulliparous woman in whose case hysterectomy is advisable the subtotal procedure is perfectly justifiable. On the other hand only a small percentage of women present themselves in such favorable circumstances. If infection is present the operation of choice is total hysterectomy.

Carcinoma developing in the remaining remnant of the cervix usually is not diagnosed until the disease is far advanced and although treatment may prolong life cure is rarely obtained. Certain surgeons maintain that total abdominal hysterectomy is more dangerous than subtotal abdominal hysterectomy. Perhaps this opinion arises partly because the surgeon elects to do a total abdominal hysterectomy in the more serious type of case.

To check this point I have compared the hospital death rate following 3085 subtotal abdominal hysterectomies with that of 1588 of total abdominal hysterectomies which were performed for fibromyomata of the uterus at our

clinic in the years 1916 to 1929 inclusive. I included only fibromyomata in both series in order to make them comparable with respect to surgical risk. The death rate in the series of subtotal abdominal hysterectomy is 1.2 per cent that in the series of total abdominal hysterectomy is 1.8 per cent. This difference of 0.6 per cent in the death rates is so small that it could arise by sampling nine times in a hundred.

From these facts I conclude that the difference in death rate between total abdominal hysterectomy and subtotal abdominal hysterectomy is very slight if any and that the higher death rate usually attributed to total abdominal hysterectomy is probably due to the selection of greater surgical risks rather than differences due to operative technique. It is also claimed that more patients would die from the complete operation than would die from carcinoma developing in the remaining stump of the cervix. If surgeons who fear to perform total hysterectomy accept the responsibility for the future life and health of the patient and feel that the cervix is a potential source of carcinoma and often a focus of infection it is suggested that they perform subtotal hysterectomy and follow this procedure 10 or 20 days later by some method of removal of the cervix or enucleation of the canal or of destruction of the cervical canal by cautery. Occasionally this procedure brings to light an otherwise hidden early carcinoma. The procedure would not increase the mortality and would accomplish all that is desired. The patient who has undergone subtotal hysterectomy only should be advised to return from time to time for observation. In some cases it may be advisable to use the actual cautery on the cervical stump or prophylactic douches in an attempt to clear up infection.

The views given have been re-established in my mind because of a recent review of cases at The Clinic which brought to light that between January 1910 and July 1930 99 patients who had undergone subtotal hysterectomy at the Clinic or elsewhere had presented themselves later at The Clinic with carcinoma of the remaining stump. In 55 per cent of these carcinoma had developed 3 years or more after subtotal hysterectomy and the longest interval was 29 years.

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not always possible to give these children the benefit of natural sunlight, exposure to the rays of a sunlamp is recommended. The inflation of toy balloons and the blowing of fluid from one bottle into another was encouraged. Repeated X-ray examinations of the chest are necessary to determine progress. Diligent postoperative care is necessary for the successful treatment of these patients.

POSTOPERATIVE COURSE

The frequent exacerbations of fever after operation have not only presented a puzzling problem but at times have been a cause of considerable discouragement. The surgeon may be elated over a normal temperature that has lasted for several days or a week, when lo and behold, on his rounds the next morning he finds that the temperature has risen to 103 degrees F or higher. Such experiences of disappointment may occur several times during the postoperative course of empyema. At times these rises in temperature may be explained by the persistence of a bronchopneumonic process, the occurrence of a fresh pneumonia, the plugging of a drainage tube, or by the encapsulation of fluid. In one instance, a tube lost in the pleural cavity was the cause of an elevated temperature. Acute otitis media was a complicating disease in 26 patients, 21 per cent of the group. This large number of ear infections suggests proper prophylactic care of the nasopharynx during the course of pneumonia and empyema. Other complications were measles, nephritis, abscess of the buttocks, abscess of the chest wall, German measles, multiple lung abscesses, pyæmia, gangrene of the wound, catarrhal jaundice, and cerebral embolism.

The patients who recovered regained their normal color, gained weight as convalescence progressed and when seen in the followup clinic weeks and months after discharge from the hospital were found to be in very good health. Curvature of the spine often mentioned as an after effect of empyema was not observed in the patients studied.

Having presented these data and having given a numerical value to our methods of treatment, it would seem incomplete if no attempt were made to compare notes with other workers in an endeavor to learn from those who have employed other surgical procedures, methods of hastening convalescence, diminishing complications, and reducing mortality.

Reinhoff and Davison, in a study of empyema in children under 2 years of age, report a mortality of 29.2 per cent in 24 children treated by the open method with rib resection, and 50 per cent in 22

treated by trocar and cannula. They are of the opinion that "better results can be obtained by the use of one operation, the open thoracotomy in all cases."

Binney, using a closed method of treatment, reports 35 children under 10 years of age with a mortality of 14.2 per cent. In 100 cases, including adults, so treated, he had to resort to secondary rib resections in 21 instances. It is noteworthy that these secondary operations had to be performed in 30.6 per cent of the cases in which closed drainage was combined with intercostal puncture and in only 19 per cent of the cases in which closed drainage followed rib resection.

Hart reported 35 patients of all ages treated by tidal irrigation. Among these are included 12 children under 2 years of age, of which 2 died, giving a mortality of 16.6 per cent. Of a total of 6 deaths in 35 patients of all ages, 5 were in children under 10 years of age.

Singleton reports 13 children under age 5 treated by a closed method of drainage. Among these there was only 1 death giving a mortality of 7.6 per cent.

Douglas, discussing the treatment of empyema by partial rib removal and closed drainage, reports 2 deaths in 13 children under 2 years of age, giving a mortality of 15.4 per cent and an older group of 35 children up to age 16 of whom 2 died giving a mortality of 5.7 per cent. In the latter group there were 8 children 10 years old and over, among whom the mortality is generally very low.

Hudson, in an analysis of 32 children treated by intercostal closed drainage, reports 6 deaths or 18.7 per cent mortality, only 12 recoveries from this method alone and 14 who were later subjected to rib resection. The same author, discussing 40 patients in whom rib resection was performed as a primary procedure, reports 5 deaths or a mortality of 12.5 per cent. However, if we add to these the 14 cases originally treated by closed, under-water drainage who later required rib resection, his mortality for patients treated by rib resection is reduced to 9.2 per cent. He concludes "Rib resection for empyema in children as a primary operation in selected cases, or preceded by repeated aspiration or intercostal closed drainage is a valuable therapeutic procedure." Children in this group treated by intercostal closed drainage required a postoperative stay in the hospital of 32.5 days, those treated by rib resection 30.5 days, while for those requiring secondary operations it was 48 days.

Ladd and Cutler, in a paper entitled "Mortality from Empyema in Children," report 268 cases of which 42 were treated by a closed method and of

After anesthesia was induced a preliminary aspiration of the pleural cavity was made and when pus was obtained the needle was left *in situ* to act as a guide. Usually the eighth or ninth ribs in the postaxillary line were chosen for partial resection or the corresponding inter spaces for simple intercostal incision. Whatever operation was performed an attempt was always made to remove the large chunks of fibrin which very often plug the drainage tubes. This procedure not alone facilitates drainage but makes convalescence less stormy.

In 5 of the cases in this series an intercostal incision was made and a rubber tube was introduced into the pleural cavity for drainage. In 96 patients a segment of rib was resected and rubber tube drainage was established. In some of these patients as soon as the tube was introduced a piece of rubber dam was placed over the opening to act as a valve permitting escape of pus but preventing inflow of air. This detail did not seem to affect the postoperative course of the disease.

Eliminating deaths those released and 6 children who returned for further observation or treatment we have 18 cases of simple intercostal incision with an average postoperative stay in the hospital of 31.9 days and 79 cases of rib resection with an average postoperative period of 35.6 days.

Of 11 patients who died 6 had had intercostal incisions and 5 partial rib resections but one must bear in mind that those on whom simple thoracotomy was performed were desperately sick children 3 of whom died within 1 day after operation and the remaining 3 within 8 days.

Among 6 children discussed above under the heading Readmissions 2 had had simple intercostal incisions and after readmission required no additional surgical intervention while of 4 who had had partial rib resections 3 required additional surgical treatment.

Comparison between the two methods is precluded by the small number of patients in the first group. My impression is however that if simple intercostal incision were employed on a larger number of children the results if not better would at least be as good as those following partial rib resection. Simple intercostal incision should be the preferred method for the very sick children of all ages and for the very young.

DEATHS

Ten patients died while in the hospital giving a mortality of 8.1 per cent. If we add to these 2 deaths about which we learned after the children had been removed from the hospital against ad-

vice we have a total of 12 deaths and a mortality of 9.7 per cent. One child on whom no operation was performed died a few hours after its admission to the hospital. Omitting this case we have a postoperative mortality of 9 per cent. Three children were so acutely ill at the time of admission that they died within 24 hours after operation. A child who had died after it had left the hospital had a complicating acute mastoiditis. Other complications in this group were measles in 1 case, gangrene of the wound in another and bilateral acute mastoiditis in 1 case. A child 18 days old had a pyæmia and the staphylococcus aureus was isolated in the pus while another child who had a pneumococcus type 1 empyema developed a streptococcus hemolyticus blood infection. It is apparent that the complications of empyema contributed at least 50 per cent of the mortality.

If we examine our mortality at the various ages we find that in children 1 year old and under it is 30.7 per cent, that for those 2 years old it is 16.6 per cent, for those 2 years of age and under it is 22.7 per cent and that for children 3 years of age and under it is 14.5 per cent. In the third year we have a group of 24 children 1 of which died giving a mortality of 4.1 per cent for that age. In the fourth year there are 22 cases and 2 deaths. One of these deaths however was that of a child on whom no operation was performed and who died soon after its admission to the hospital. The postoperative mortality for age 4 is therefore 4.7 per cent. In the fifth year there are 10 cases and 1 death giving a mortality of 10 per cent. For 86 cases therefore of children 5 years of age and under the postoperative mortality is 12.7 per cent. In 36 cases over the age of 5 there was 1 death giving a mortality of 2.7 per cent. The age of the patient is a determining factor in the mortality from empyema.

POSTOPERATIVE TREATMENT

Our postoperative treatment has been very simple. Frequency of dressings was determined by the amount of drainage and temperature a rise in the latter suggesting at times the plugging of a drainage tube and the consequent retention of pus. Irrigation of the pleural cavity was not employed regularly. Some children whose pleural cavities were irrigated with a variety of fluids did not seem to progress better than those children whose pleural cavities were not irrigated. The introduction of fluid to determine the capacity of the cavity is an advisable procedure. All children were given generous diets and were kept on the porch whenever the weather permitted. As it is

Simple intercostal incision with open drainage is the preferred procedure in the very sick and in infants, rib resection for all other children

Local infiltration with novocain should be used whenever possible and can be used in most cases

The complications of empyema, and not the disease itself, seem to play the greater part as contributors to the mortality from this disease

Acute otitis media, in some cases complicated by acute mastoiditis, was the most frequent complication. Proper prophylactic care of the nasopharynx is recommended

Diligent after-care, next to operative method, is important in surgically treating this disease

The value of operative methods must be measured not by the resulting mortality alone but by their ability to shorten the period of convalescence, to diminish the incidence of secondary operations, and to prevent chronicity

The writer is indebted to the various members of the surgical staff of Lebanon Hospital for permission to use their case records

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these 12 or 28 per cent died. It was necessary to perform secondary operations in order to secure proper drainage in 21 or 50 per cent of the group so treated. On the other hand 26 patients treated by rib resection gave a mortality of only 15.9 per cent and only 4 per cent required secondary operations. This contrast is striking.

Farr and Levine report 226 cases treated by the open method using rib resection or intercostal incision. They report the results of a group of operators. In 168 cases of rib resection there were 30 deaths a mortality of 18 per cent. Intercostal incision with open drainage was employed in 58 instances. Among the latter 9 or 3.5 per cent died. This higher mortality is undoubtedly due in a great measure to the fact that the latter group was made up of children who were very sick at the time of operation and who were not exposed to the added shock of rib resection. One of the surgeons who used the intercostal incision exclusively contributed 26 cases to the group studied of which 4 children or 15 per cent died. For children treated by rib resection the post-operative stay in the hospital was 62 days while for those treated by intercostal incision it was 5 days.

Foster who treated his cases of empyema by rib resection with constant negative pressure for continuous suction reports a mortality of 21.7 per cent for children under 2 years of age and 5.7 per cent for children 2 to 11 years old. He obtained complete healing in 7 weeks and 2 days.

McNery and Brennen report an interesting experience with the treatment of empyema in children by repeated aspiration only. Thirty-three children are included in this group of whom 3 died giving a mortality of 9 per cent. The average stay in the hospital for the children so treated was 3 months as contrasted with 2½ months for children treated by the same workers during the preceding year by the open method. Our experience with repeated aspirations in children would not prompt us to resort to that procedure as a sole method of treatment. At times when the pus became very thick we were able to aspirate only small quantities at a time insufficient to give the patient even temporary relief.

Comparisons are rendered difficult by the inequality of age distribution in the various groups studied by the differences in the sizes of the groups and by differences in the periods of time during which the particular cases occurred. The degree of accuracy of a mortality rate for a group of 12 or 13 children treated by a particular

method cannot be compared with a group of 300 times as large treated by another or by the same method.

About 6 years ago the writer studied a small group of cases of empyema in children treated by the open method without a single death. However he realized that the next few cases so treated may change the entire picture. The extended analysis of a larger group as presented in this study shows how results will differ when the same surgeons and the same methods are employed. Similarly deduction from a study of a group of children whose illness occurred during a single season or year cannot be as truly instructive as the analysis of a group that is spread over a period of years and that consequently includes cases of empyema that complicate pneumonias of varied duration.

Although the writer is not at all satisfied with a mortality of 9 per cent for children of all ages and the considerably higher mortalities at the younger ages it seems to him and he is so impressed by the published studies of other investigators that open drainage preceded by repeated aspiration is the choice operative method. The results presented from a study of this group seem to compare favorably with those of other surgeons who use the same methods and with numerous reports from those who use closed drainage. To be convinced of the efficacy of special procedures one should like to see the results in larger groups of children treated by those particular methods. Although a preference is expressed for the open method of drainage it is felt that doubt may be removed by the treatment of acute suppurative pleurisy in children. The disease will have a better mortality that will remain unchanged whatever methods employed and that in the very young this mortality rate will continue to be high. The greatest contribution in recent years toward the treatment of this disease was its elimination from the category of diseases requiring immediate surgical intervention and the introduction of repeated aspiration as a preliminary treatment. Newer methods must be measured not alone by the resultant mortality but especially by their ability to lessen the period of convalescence to eliminate secondary operations and to prevent chronicity.

CONCLUSIONS

From a study of 123 cases of acute suppurative pleurisy in children and of comparative data, it is felt that the open method of drainage preceded by repeated aspiration is the choice method of treatment.

Simple intercostal incision with open drainage is the preferred procedure in the very sick and in infants, rib resection for all other children

Local infiltration with novocain should be used whenever possible and can be used in most cases

The complications of empyema, and not the disease itself seem to play the greater part as contributors to the mortality from this disease

Acute otitis media, in some cases complicated by acute mastoiditis, was the most frequent complication Proper prophylactic care of the nasopharynx is recommended

Diligent after-care, next to operative method, is important in surgically treating this disease

The value of operative methods must be measured not by the resulting mortality alone, but by their ability to shorten the period of convalescence, to diminish the incidence of secondary operations, and to prevent chronicity

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MAGGOTS IN THE TREATMENT OF CHRONIC OSTEOMYELITIS INFECTED WOUNDS AND COMPOUND FRACTURES

AN ANALYSIS BASED ON THE TREATMENT OF ONE HUNDRED CASES WITH A PRELIMINARY REPORT ON
THE ISOLATION AND USE OF THE ACTIVE PRINCIPLE

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INVASION of infected wounds by maggots is as old as medical history and reports of such invasions have usually shown benefit to the sufferer. A review of the literature shows only a few references to this form of treatment (1, 2, 3).

Scientific and controlled use of maggots as a theapeutic agent in the treatment of chronic osteomyelitis and complications resulting from fractures is a development of the World War. The late Dr. William S. Baer of Johns Hopkins the originator of this therapy was the first to use maggots as a living antiseptic in 1928. Since Dr. Baer's first report in 1929 this treatment has been much discussed in America and abroad. References and discussions have appeared in the columns of nostrums and quackeries in the scientific and popular journals, magazines, newspapers and before the medical associations.

Chronic osteomyelitis infection complicating fractures and infected traumatic lesions are important clinical and economic orthopedic problems. Bacteria which are in the clothing and on the skin when carried into the wound at the time of injury cause such complications. In many cases the chronic osteomyelitis develops spontaneously from active infection within the body. The offending organisms are carried from the focus by the blood stream into the medullary canal where the nutrient artery with resulting single or multiple areas of destruction which clinically become active following trauma. This type of infection promptly resolves itself into a chronic state. It heals superficially breaks down and reveals only again to break down over a period of years with a chronic discharging sinus or sinuses and gradual depletion of body resistance. Extension to other bones of the body not infrequently occurs. These patients become chronic invalids. The sinuses or sinuses become infected from the surrounding skin. There results great undermining of soft tissue progressive destruction of one or more bones with sequestrations and the production of involucres incorporating pockets of infection. The usual history is attended by repeated operations and accompanying neuroses.

The recurrence or continuance of the infection in these cases has stimulated various methods of treatment. Comment upon these methods is not within the scope of this report. Suffice it to say that recurrence results from incomplete removal of infection at the time of operation, inadequate postoperative care and depletion of body resistance plus a virulent offending organism.

Ninety-five per cent of our cases have remained healed from 6 to 18 months. Statistics beyond this period are not available. The large percentage of recoveries is assumed to be due to a radical sequestrectomy or debridement plus the activities of the maggots. The postoperative use of the scavengers supplements the operation and completes the work of the surgeon. They appear to seek out the small and discovered pockets of infection not removed at the operation feed upon and digest the bacteria and the infected detritus present. This probable mechanical factor of effectiveness cannot be supplied by chemical antiseptics nor by the surgeon at subsequent dressing. The presence of the maggots does not have the irritating and destructive effect of antiseptics upon surrounding tissue. Continued observation and experiments however seem to cast some doubt on the correctness of this assumption. The healing process is due probably to factors usually lying in the mechanical phase.

TYPE OF MAGGOTS USED AND THEIR PRODUCTION

The maggot (Fig. 1) of the green bottle fly (Calliphora erythrocephala) family Muscidae (Fig. 2) is employed. The flies of this family normally breed only in the late spring summer and early autumn months in their natural habitat. One of our early problems was the continuous breeding of flies during the winter. This has been solved by the use of a specially constructed bioterrarium in an atmosphere of constant temperature and humidity (Fig. 3). The temperature is maintained at 72 degrees Fahrenheit the moisture regulation (Fig. 4a). The atmosphere must be about 40 per cent saturation. This is accomplished by a water pan in the bottom of

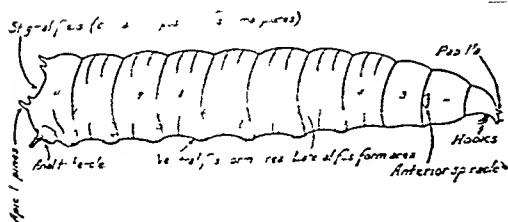


Fig 1 Characters of a muscid fly larva (Greene) Segment 1 is the head, 2 to 4 are thoracic segments, 5 to 11 are abdominal. Segment 11 really contains the seventh to tenth abdominal segments the spiracles being on the eighth, the anus in the tenth

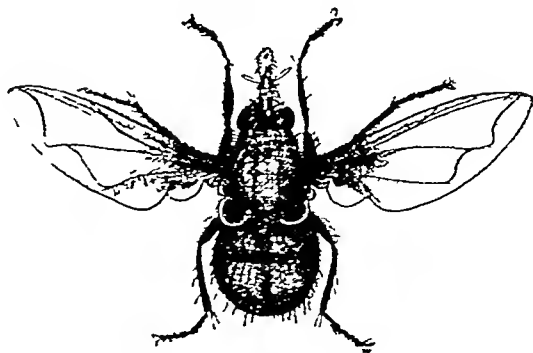


Fig 2 The female blow fly (*Calliphora erythrocephala*)

each compartment (Fig 4, b) The air within the incubator must be in continuous motion without drafts, which is accomplished by intake and exit air chambers within the base and ceiling of the incubator (Fig 3, a and b) Dr Karrer, of the Maryland Academy of Science in Baltimore, planned these air chambers The flies are fed on liquid honey and water, equal parts, to which a small amount of yeast is added because of its vitamin B content This syrup is poured over a piece of white bread in a Petri dish, placed on the bottom of each fly cage within the compartments of the incubator The fly cages are constructed of steel hoops covered by gauze bags with an opening in the side and top (Fig 4, c)

On the floor of each fly cage is a second Petri dish containing a strip of raw, fresh beef, on which the flies lay their eggs (Fig 5, a) The flies are fed and the eggs are collected daily through the opening in the side of the gauze bag The eggs hatch into maggots within 24 hours The maggots remain as such for 7 days and grow rapidly during this period They then undergo a second change forming pupas In this form they are dormant and require no food When the maggots are 6 days old, they are transferred to fine sand in Petri dishes in which they pupate (Fig 6, b) They remain as pupas in the sand 14 days, then again metamorphose into fully grown flies The females under the controlled atmospheric conditions within the incubator begin to lay after 5 days, a shorter time than in their natural habitat, which time is 21 days

STERILIZATION OF MAGGOTS AND CULTURE CONTROLS

As the eggs are gathered each day, they are sterilized for 1 hour in 1:1000 bichloride of mercury containing 25 per cent of 95 per cent alcohol They are then transferred aseptically to sterile agar and beef slants in test tubes, on which they hatch and feed until used The eggs rather than

the maggots are sterilized because they have not yet developed an intestinal tract The sterile food within the test tube assures that the intestinal tract as it develops will remain sterile A few eggs from each batch are introduced into glucose broth stratified with mineral oil and incubated at 37 degrees C for anaerobic growth If these cultures are cloudy, the maggots from which they are a sample are discarded Before implantation the maggots are again bathed in a solution of 1:1000 bichloride of mercury containing 25 per cent of 95 per cent alcohol for 1 hour and washed repeatedly with normal salt solution to free their surfaces from possible infection and culture tube detritus

SUMMARY OF CASES

1 *Infected fractures* Five cases consisting of compound fractures of the lower third of both bones of the forearm, of the middle third of both bones of the leg, and crushed wounds about the ankle joint

2 *Tuberculous osteomyelitis* Four cases involving bones about the elbow joint

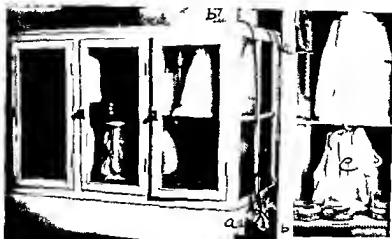
3 *Chronic pyogenic osteomyelitis* Ninety cases involving the femur, tibia, small bones of the foot and humerus Seventy per cent of our cases within this group involved the femur, probably because of the large blood supply of this bone Twenty per cent involved the tibia and have a history of trauma

4 *Infected stump following repeated amputations* One case

In this series 2 cases failed to respond to treatment which with 2 recurrences and 1 death gives a total of 95 per cent of cases healed

TREATMENT

No case with the hæmoglobin less than 70 per cent or a red count less than 4,000,000 is consid-



F 3 left I l k h mb h t h mb
F 4 Th m t t gulat b pp t p fly g

ered for operation. In compound comminuted fractures a radical debridement is completed and a reduction is accomplished if possible. In tuberculous and chronic pyogenic osteomyelitis a radical equestrectomy is performed. These wounds are not sutured but are packed with plain sterile gauze for 48 hours to control hemorrhage. The gauze is removed at the first dressing the wound is thoroughly irrigated with normal saline and maggots 48 hours old are introduced. The number of maggots introduced depends upon the size of the wound. This treatment is repeated every 3 to 5 days depending upon the severity of the infection. At each dressing the wound is washed thoroughly with normal saline and new maggots are introduced. This procedure is followed until the wound completely fills with granulation tissue.

Preparation of carrier for use. At operation the skin is prepared with green soap and sterile ether.



T 5 At left g d maggots w b f t ght
p p s a d

Drapes are applied in the usual manner. Antiseptic is not used at time of operation nor about the wound when drapes are applied. The skin may be cleansed by ether or boric acid ointment may be applied because of skin irritation.

Dressing. The dressing consists of four layers of nonsterile crêpe (fine mesh) alternated with four layers of fine linen gauze cut to the desired size. Four adhesive strips of proper length and 3 inches wide are cut and fastened with nonadhesive surfaces upon the wound. The adhesive strips are placed in a rectangular manner with the folded borders along the skin margin of the wound (Fig. 6a). After the maggots are introduced (Fig. 6b) the moline and gauze dressing is quickly placed over the wound so its border sits upon the center of the folded strips of adhesive. The dressing is then held to the skin by three adhesive strips of the proper length placed also in a rectangular manner over the borders (Fig. 7). The dressing is undisturbed to nature for a total of eight to 20-30 hours. This causes the maggots to bury themselves into the crevices of the wound.

CHARACTER OF THE DISCHARGE AND METHOD OF HEALING

In about 24 hours after each dressing the wound generates a brown hard fenestrated foam which fills the dressing. The amount of discharge is about five times that of a yodine method of treatment. This reaction is repeated following each dressing throughout the period of healing. The discharge consists of serum bacteria pus and a healing secretion (a principle) the origin of which has not as yet been



Figs 6 and 7 *a*, Folded adhesive strips placed in rectangular manner about the wound, after the maggots are introduced within the medullary cavity, *b*, the gauze is placed over the wound and the dressing is completed (Fig 7, at right)

determined but is now being investigated. After the third or fourth application the maggots which in the earlier applications remained alive 3 to 5 days, now live only 1 to 5 hours. This is because the active principle has increased in virulence, and the hydrogen-ion concentration of the wound has shifted to higher levels. In this active principle and increased hydrogen-ion concentration the maggots cannot survive. The wound rapidly fills under stimulation of this active principle with an excessive production of healthy and pink granulation tissue, the color of which and the rapidity of production are in marked contrast to the less healthy granulation produced in wounds treated by other methods.

THEORY OF MAGGOT ACTION

1 *Mechanical action* Because of scavenger activities of the maggots, it is assumed that they seek, devour, and digest bacteria as well as the wound debris adherent to the surface.

2 *Serum production* The reason for the increased wound secretion is not known, but it is probably due to local stimulation from the continuous crawling of the maggots and their persistent attack upon the necrotic tissue in the wound, thus opening new channels for the free flow of tissue fluids.

3 *Active principle production* It is not thought that actions one and two in the foregoing paragraphs are entirely responsible for the healing of the wound. A series of experiments are now being carried out in the clinical laboratory and on the orthopedic service at Edward Hines Hospital which have revealed the presence of the aforementioned active principle. This active principle when isolated has been effective in curing several of our cases. The results of these experiments when completed will be reported as original work in a second article of this series.

SUMMARY AND CONCLUSIONS

There can be no question as to the healing value of the maggot or larvæ treatment in all

forms of chronic osteomyelitis, infected wounds, and complications following fractures. The interest aroused by the results obtained would naturally lead to an investigation of the reason for the effectiveness of this treatment. Our experiments would seem to show that it is not merely the mechanical action of the maggots, i.e., feeding, rapid movement, et cetera, in the wound, but rather that some additional agent is developed that aids in the healing process. This conclusion seems warranted when we consider that paste made from the dead bodies is also effective as a curative agent. That additional agents are probable in effecting the cure seems to be clearly demonstrated by the use also of filtered extracts from the bodies of the dead larvæ. This would seem to point clearly to the presence of some agent which in itself is sufficiently powerful to overcome infections and permit the normal hydrogen-ion concentration balance to be established. The agent believed to effect this result is a bacteriophage. This opinion is warranted from the fact that filtered uncontaminated products derived from the bodies of larvæ in culture were quite as suitable as the living maggot, and from the fact that, when these cultures were brought into contact with pyogenic organisms in Petri dishes, cultures were destroyed. It is equally possible that tissue derivatives are also potent agents in the healing process. This phase is being studied and will be reported at an early date.

SUMMARY

1 In a series of 100 cases including infections resulting from fractures, tuberculous and pyogenic chronic osteomyelitis, and an infected stump following repeated amputations we have had 95 per cent cures.

2 The success of this treatment does not alone depend upon the scavenger activities of maggots.

3 A series of experiments to be reported at an early date would seem to show that some additional agent is developed within the wound which is sufficiently powerful to overcome infection and

permit the normal hydrogen ion concentration balance to be established. This agent is believed to be a bacteriophage.

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INTRAPERITONEAL HERNIORRHAPHY IN INGUINAL HERNIA

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It is unnecessary to go into details of anatomy which are so well known. Reference therefore is made only to such anatomical facts as may help in the discussion of the subject.

THE MUSCLES

Of the muscles responsible for guarding the inguinal canal the transversus abdominis forms the conjoined tendon along with the internal oblique and protects the posterior wall of the canal at its inner end. The muscle crosses over the inguinal canal in the rest of its extent and is placed half an inch to three quarters of an inch above it.

The internal oblique muscle forms the anterior boundary of the canal over its outer half and its posterior boundary at its inner end. Its fibers arching over the canal from below back and form the roof of the canal over its middle portion. The explanation of this peculiar relationship of the muscle to the canal lies in the fact that it is split in two at its inner end and about one half inch above its lower margin by the passage through it of the testis and the cord. Both at the same time carry with them as a covering the lowermost fibers of the muscle which form the cremaster muscle. These fibers cover the cord in front and at the sides in loop formation from the external abdominal ring down to the testis.

The inner limb of these looping fibers form a bundle which is inserted into the tubercle and crest of the pubic bone. The outer halves of the loops form a fasciculus on the outer side of the cord behind the outer pillar of the external abdominal ring and run parallel and outward parallel to the inguinal ligament and merge in the internal oblique muscle near the apex of the external ring. Thus between the lower edge of the conjoined tendon and the outer fasciculus of the cremaster an angular space intervenes.

THE ACTION OF THE MUSCLES

The contraction of the transversus abdominis by its lift shortens and straightens out its fiber arching over the canal. This action brings down to some extent like a shutter the lower margin of the muscle but owing to its situated three quarters of an inch above the canal it gives the canal no protection. Further this contraction by increasing the intra-abdominal pressure pushes the abdominal viscera into any fossa opening or canal—i.e. traperitoneal or extraperitoneal—communicating with the abdominal cavity. The only protection against an inguinal hernia is derived from the aponeurosis of the external oblique and the lower portion of the internal oblique muscle.

This muscle however is thin and pale in structure where it lies over the inguinal canal and consequently its contraction provides only a feeble barrier against a hernial protrusion.

In contracting the cremaster not only pull up the testis and the cord but acting simultaneously with the internal oblique covers up the angular space lying between the two. All the various actions of the muscles can be appreciated by inserting a finger into the inguinal canal and asking the patient to cough.

The external abdominal ring varies considerably in size and occasionally is too small even to admit a finger into the canal. The normal internal abdominal ring oval in shape is from about a half inch to one centimeter in its longitudinal diameter which is more or less eccentrically placed. By the introduction of the index finger the little finger into the canal the margins of the ring may be palpated and while the patient coughs the impulse of the abdominal viscera pushing out the peritoneal dimple diaphragm of the unobliterated inguinal process as the case may be can in every instance be appreciated.

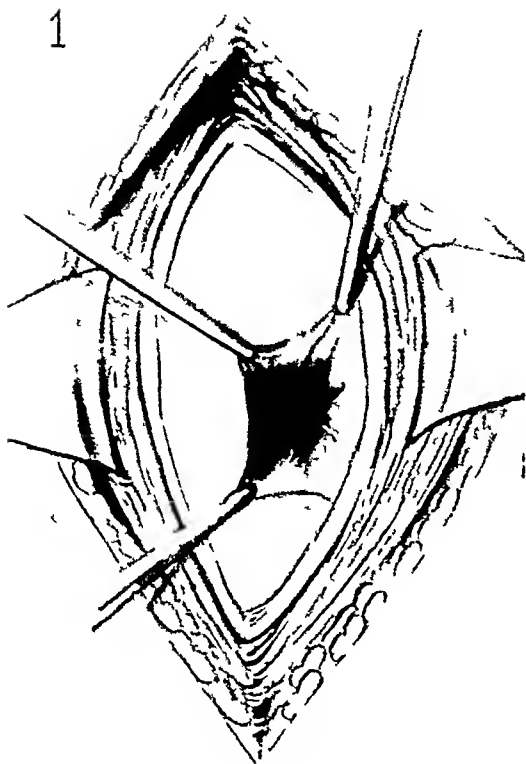


Fig 1 Abdomen opened by right paramedian incision with patient in the Trendelenburg position. Abdominal opening of a right inguinal hernia, demonstrated by picking up the peritoneum $\frac{1}{4}$ inch from its margin

The transversalis fascia from the level of the inguinal canal downward is thick and strong. The internal abdominal ring with its palpable margin is placed in the transversalis fascia about half an inch above the middle of the inguinal ligament.

The peritoneum in the lower part of its extent anteriorly and where it covers the iliac fossa and the pelvis is loose and abundant. On the posterior surface of the anterior abdominal wall in the region of the internal ring, a slight peritoneal dimple or a still deeper diverticulum or even an unobliterated vaginal process may be seen, and the depth of this may be ascertained by means of a finger.

THE NERVES

The external oblique aponeurosis, the internal oblique and the transversus abdominis muscles in the inguinal region are supplied by branches of the

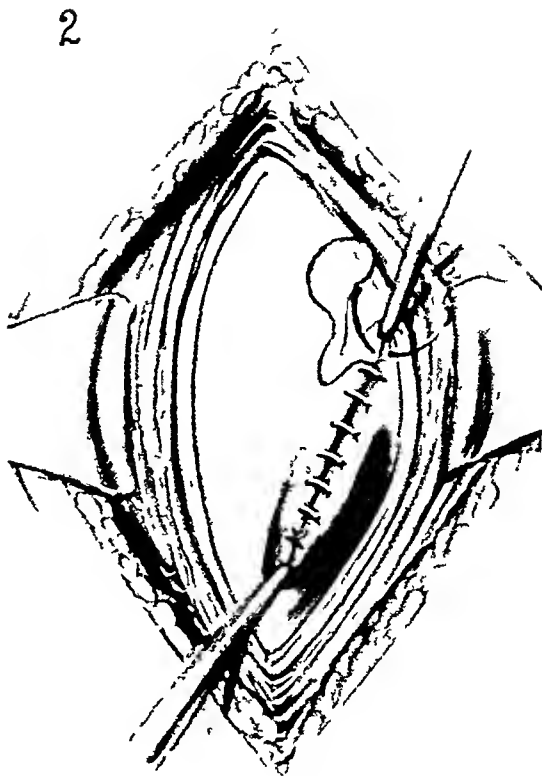


Fig 2 The ends of the hernial opening held by forceps while it is being closed by a continuous catgut suture. Along with the peritoneum retroperitoneal fatty tissue and transversalis fascia are included in the suture. There is no risk of including the cord in the suture as it lies $\frac{1}{4}$ inch to 1 inch away from the margin of the inner opening of the sac.

iliohypogastric and the ilio-inguinal nerves. The ilio-inguinal nerve is the principal nerve in this region and supplies several twigs to the muscles here. In an operation for inguinal hernia, while it is easy to preserve the main trunks of the nerves, their small motor branches are sacrificed. The main trunks where they terminate are sensory in function.

THE ARTERIES

The blood supply of the inguinal region is derived from the superficial epigastric and the superficial external pudic. These arteries and their branches are endarteries, except for an occasional branch anastomosing deeply with the inferior epigastric, and lie across the inguinal canal and are divided by the incision for an operation for inguinal hernia.

3



4



Fig 3. The normal position of the internal ring and the descent of the testis through the inguinal canal.

ETIOLOGY OF INGUINAL HERNIA

Inguinal hernias are said to be of two kinds, congenital and acquired. While it is admitted that most hernias in children, adolescent and young adults are congenital, it is also stated that a certain proportion of such hernia occurring in middle aged persons are acquired as a result of traction on the internal abdominal ring in individuals with low and abnormally pendulous scrotums due to weakness of the cremasteric reflex.

In such an individual it is said that the cremasteric reflex is weak and the internal ring is only feebly contracted. In operating on such a hernia the sac which is thick and has a very wide neck is found to be lined up with the abdominal cavity. The congenital sac on the other hand is described as lying over the cord and is held in place by its mesentery. This sac is said to be thin and to have a narrow neck and is only lightly adherent to the cord which it covers anteriorly and

Fig 4. Loops of the internal ring and the descent of the testis through the inguinal canal. The diagram shows the internal ring as a constriction point, and the testis descending through it. The diagram is signed 'H. P. Jacobs 1931' and 'U.R.'

at the descent. It is shaped like a horseshoe in section.

The etiological factors are believed to be various kinds of increased intra-abdominal pressure.

In discussing the etiology of inguinal hernia, it is considered that the majority of such hernias are congenital, characterized by a small proportion of them descending through the peritoneal diaphragm which are all represented by obliterated vaginal processes and so-called

congenital It is not necessary to explain their presence by the theory of cremasteric incompetence

On an examination of the posterior surface of the anterior abdominal wall of 200 male patients of all ages, whose abdomens were opened for causes other than hernia, the writer found dimples over the internal abdominal ring of varying depths present in 199 patients and one patent vaginal process in a boy of 7 years still unoccupied by a hernia The presence of a dimple at the femoral ring was also invariable

The adhesion, the thickness of the wall, and the intracordal character of the sac of the so called "traction hernia" are due simply to the age of the hernia The older the hernia, the wider is the opening in the neck of the sac, owing to the steadily increasing hernial contents

The movements of reduction and descent of the hernia and the pressure of its weight are sources of irritation which produce a condition of chronic inflammation of the sac leading to thickness of its wall and adhesion to surrounding structures

The intracordal position of the sac is due to the same reasons As the constituents of the cord are very loosely attached to each other, the movements of the hernial contents and their weight flatten out the cord, separating its various components from each other

The presence of a dimple or diverticulum of varying depth can be further demonstrated as stated previously, by introducing a finger into the canal of any individual and asking him to cough It is not possible to obtain it in about 5 per cent of cases owing to the impossibility of introducing the finger through a very small external ring In the majority of cases the diverticula being shallow, i.e., being mere dimples, the impulses they convey can be appreciated only on very careful examination

If traction had been the cause of inguinal hernia, this disability would have been most common in India where large, pendulous, and very heavy scrotums, due to large hydroceles or elephantiasis of the scrotum, or to both, are so prevalent

Yet, in 502 cases operated on for these conditions by the writer and his junior colleagues in 5 years, only 2 cases of hernia were found, of which one was in a boy 2 years old in whom a hydrocele co existed with the hernia in a congenital sac

It will also be noticed that even in hernias in which the various elements of the cord are found to surround the sac, its anterior surface has nothing in front of it and can always be safely incised without the risk of injuring any of the constituents of the cord

The predisposing factors, therefore, are

- 1 The presence of peritoneal dimples, diverticula, and completely patent vaginal processes

- 2 Comparative weakness of the internal oblique muscle as against the transversus abdominis

- 3 Visceroptosis due to any cause whatever

- 4 Adiposity, which causes muscular flabbiness and considerably increases the weight of the viscera

- 5 Any condition which leads to general emaciation and loss of muscular tone

The determining factor is a constant pressure exerted on the peritoneal protrusion into the ring aggravated by periods of further increase of pressure at more or less regular intervals Visceroptosis, chronic intestinal disorders such as constipation, diarrhoea, and colitis, which cause flatulence and continuous intestinal distention are every-day examples of constant pressure, which wear away muscular tone and resistance Thus in many persons, who subsequently develop hernia, the history of a premonitory symptom of aching pain over the inguinal region often extending backward to the lumbar area, i.e., in the direction of the distribution of the ilio-inguinal nerve can be obtained

The periodical increase in pressure may be derived from many disorders connected with the genito-urinary, gastro-intestinal, and respiratory systems or from the patient's occupation Of these, intestinal disorders necessitating straining at stool are the most frequent causes

One sudden and very great increase of intra-abdominal pressure may cause the descent of a hernia into a congenital sac or the strangulation of an already existing hernia but is not responsible for those hernias in adults which for a better name may be called acquired and which take a long time to make their presence apparent

PATHOLOGY

The skin loses its firmness, becomes loose, atrophied, and in very old standing cases is thrown into folds

The internal oblique and the cremaster muscles are partially atrophied They are thinner and paler with considerable increase of areolar tissue between the fibers Microscopically the fibrous tissue shows a round-cell infiltration Occasionally, however, I have noticed in the early stages some hypertrophy of the cremaster fibers The other fascial coverings over the hernia are thin and inconspicuous

The sac, however, progressively gets thicker, loses its pearly white tint and becomes opaque,

coarsely fibrous and adherent to its coverings and to the constituents of the cord. Microscopically it has the features of chronic inflammation.

The contents of the sac show fatty infiltration. There is considerable increase of fat between the mesenteric leaves in the appendices epiploicae and in the omentum if they or any of them form the contents. These changes are due to venous stasis and diminished oxidation.

Adhesions between the sac and its contents are also sometimes observed.

SYMPTOMS

I wish to touch on only two points in the symptomatology of inguinal hernia. One is the pain complained of as radiating from the lumbar to the inguinal region long before there are any signs ordinarily accepted as those of a hernia. This symptom can be elicited from most intelligent and observant patients. The special features of the pain are that it is often brought on by standing and relieved by lying down and is aggravated on straining. The greatest intensity of the pain directly over the position of the internal abdominal ring is often well marked but is not always so.

It is the sensory reflex of the irritation of the branches of the ilio-inguinal nerve distributed to the internal oblique muscle caused by the pressure of a hernial protrusion into a peritoneal dimple or diaphragm. This premonitory symptom is often treated as neurasthenia or something more serious as chronic appendicitis.

Secondly, a dull aching pain in the inguino-scrotal region is a common complaint of patients suffering from an old established hernia. It is more marked in the region of the external abdominal ring and is due to neuritis of the ilio-inguinal nerve the result of constant pressure of the hernia.

The sufferer wears a scrotal support which alleviates the pain to a great extent. This pain is often associated with a dragging pain in the lumbar region caused by the pull on the mesentery of a very large hernia consisting chiefly of omentum and ileum.

TREATMENT

In the operative treatment of an inguinal hernia we have to remember the following facts:

1. It is the result of a constant and abnormally high intra-abdominal pressure reinforced by a still greater increase of pressure at more or less regular intervals on a peritoneal dimple diverticulum or a patent vaginal process.

2. The gradual increase in the size of the sac is provided by the loose parietal peritoneum of the iliac and pelvic fossae.

3. The external oblique aponeurosis and the internal oblique muscle have proved incompetent successfully to withstand the abnormally high intra-abdominal pressure and as a result of the pressure and strain of the hernia the internal oblique muscle and fasciae are atrophied and in some cases neuritis of the ilio-inguinal nerve is generated.

The aims of an operation with a view to prevent recurrence should therefore be as under: (1) to close the internal abdominal ring in a way that no peritoneal dimple is left; (2) to tighten up all loose and redundant parietal peritoneum in the hernial region; (3) to strengthen the defenses of the hernial region to enable it to withstand the abnormally high intra-abdominal pressure; and (4) to give the much needed rest to the muscles and fasciae of the inguino-scrotal area.

If we cut into the already devitalized and atrophied tissues, divide the arteries supplying them with blood and also the nerve twigs whose trophic influence they are dependent on, we cannot expect them to perform their duty of guarding the inguinal canal against a hernia. A duty in which they have once already failed under better conditions. Further it is impossible from outside and by extraperitoneal manipulation to close the neck of the sac in such a way as not to leave an intra-peritoneal dimple and tight up all loose and redundant peritoneum.

The operation to be described has been performed by the writer in 66 cases of inguinal hernia of which 3 were recurrent ones without a recurrence in a single case for a period varying from 6 months to 3 years.

It is not necessary to perform this operation in congenital hernia in infants and small children in whom the conditions are so different. Here the sac should be opened by an anterior incision through the coverings, the iliac peritoneum beyond and behind the neck of the sac picked up by several pairs of small forceps, pulled out and gathered up by a purse-string suture from inside and the opening thus closed without the necessity of separating the cord from the sac. The sac closed at its inner end is soonobliterated by atrophy and adhesion of its walls.

The closure of the sac in adults is performed intra-abdominally the abdomen being entered by a umbilical median incision.

The operation is simple and efficient and may be quickly performed by anyone accustomed to abdominal surgery. Bilateral hernias can be dealt

with through the one opening, and the appendix may be removed at the same time

THE OPERATION

Spinal anaesthesia administered by an experienced anaesthetist is ideal

The bladder should be carefully evacuated immediately before the operation

The abdomen having been entered by a sub-umbilical median incision, the patient is placed in a Trendelenburg position, the sac is emptied of its contents and any viscera, which may tend to encroach on the area of operation, is pushed away by gauze packing

The surgeon now standing on the side opposite to that of the hernia and facing it, can easily locate the hernial opening with the right or the left index finger according to whether the hernia is on the right or the left side

The peritoneum is then picked up with a few pairs of forceps one-fourth of an inch away from the abdominal opening of the sac and from all around it and brought together over it either by a pursestring suture or by a continuous catgut stitch

The loose parietal peritoneum lining the fossæ is then pulled up as a fold in a line parallel to Poupart's ligament and immediately behind it and is sewn onto the anterior abdominal wall above the level of the hernial opening and covering the earlier suture

The extent of the fold of peritoneum that can be thus mobilized varies in proportion to the amount of the redundant tissue in the fossæ

In stitching, care should be taken to see that no opening is left at either end of the line of suture leading into the space anterior to the peritoneal folds raised. If there are any openings, they should be carefully closed by two or three deep mattress stitches

The cord at the neck of the sac and around its inner opening is separated from it by a considerable amount of extraperitoneal fat and is not

interfered with when the opening is closed or when the parietal peritoneum is pulled up

The dimple over the femoral ring is also straightened out

Four folds of peritoneum are thus laid over the hernial opening and all loose peritoneum is tightened up

The abdomen is now closed in the usual manner

The result is excellent, the sac in time is obliterated due to its walls coming in contact and possibly also as a result of atrophy

The internal oblique and the cremaster muscles, the skin, and the subcutaneous tissues regain to a great extent their tone in the course of 6 months

The other virtues are that it does not involve the dissection of atrophied and devitalized muscles and fasciæ, the division of the arteries and motor twigs of the nerves of the inguinal region, and the mutilation of the cord in attempting to separate it from the sac

(1) Pain and hyperæsthesia over the scar due to incarceration of nerves in it, (2) atrophy of the testis due to injury to the vas or the spermatic artery, or owing to the pressure of a tightly sutured canal wall, (3) formation of a varicocele due also to tight suturing, (4) torsion of the testis due to twisting the gland during operative manipulation, (5) orchitis and epididymitis, results of rough handling of the vas or congestion of the pampiniform plexus, not uncommon complications after operations for inguinal hernia through the inguinal route, are impossible in this operation

The operation is applicable not only in all forms of inguinal hernia but also in femoral hernia

If, as it very rarely happens, an old hernia of the inguinoscrotal variety is not completely reducible on account of the fixation of some part of the content to the sac by adhesion, the sac may be opened in the scrotum and the hernia freed and reduced and the main operation undertaken a week later

I have done it at the same sitting

EDITORIALS

SURGERY GYNECOLOGY AND OBSTETRICS

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APRIL 1932

WATER

SEVENTY FIVE per cent of the energy produced in the human body is expended unconsciously in maintaining bodily temperature circulation of blood respiration digestion and other vital processes and only 25 per cent is under conscious control. Recent investigations of the unconscious expenditure of energy through the sympathetic and endocrine systems have led to new triumphs in medicine.

We are now finding some very interesting facts in regard to water in connection with medicine. A man who has received an injury to the brain has a better chance of recovery from the concussion if his water intake is reduced and it appears that epilepsy has been ameliorated by reducing water intake. Rowntree's work on water balance has given valuable information as to the relation between water and physiologic processes. We must now open a research regarding the water in our bodies in the same fashion that productive research was opened regarding the unconscious control of energy in our bodies.

Seventy five per cent of our bodies is composed of water and only 25 per cent of solids. We know much of the solids but very little about the water the element vital to life.

We know that three fourths of the surface of the earth is composed of water and that if the earth were smoothed over into a sphere there is enough water to cover it two miles deep. Water is densest in a liquid form at a temperature of 39.2 degrees F. Water expands as its temperature is increased or lowered at 212 degrees F. or above water is converted into vapor and expands to occupy 1642 times as much space as liquid water. The great power of steam is due to the enormous pressure developed by the vaporization of water.

Fresh water is expanded by cold through six pointed crystallization into ice at 32 degrees F. increasing one eleventh in volume and thereby becoming lighter hence only eight ninths of an iceberg is submerged. Salt water freezes at about 27 or 28 degrees F. the exact freezing point depending on the salt content and in this process the force of the expansion of water during freezing is so great that the salt is separated and precipitated out so that the ice is fresh. Although we know that ice and snow can be cooled to temperatures below 32 degrees F. yet under such conditions beneath the surface ice and snow are less cold than on the surface. They remain at about 32 degrees F. and are as effective insulating material as the earth's crust. We can understand why when the air is colder than the freezing point the Eskimo builds his hut of ice and snow and why various animals in countries with prolonged below zero weather make their dens in snow.

The force exerted by the expansion of liquid water into ice is almost irresistible. To break rock into fragments to be used for mechanical purposes, the ancients bored small holes in the rock, and in the winter filled them with water which, in freezing, shattered the rock.

Liquid water is 819 times heavier than dry air, but when water is vaporized, it is 132 times lighter than dry air, and therefore ascends. As vapor laden air becomes colder in rising, it forms clouds. To reconvert this cloud vapor into liquid water, some metamorphosis takes place which may be electrical in nature. We know that to produce 1 inch of rain, or 10 inches of snow, there must be suspended over each acre 113 tons of water in the form of vapor clouds.

All forms of life began in water, a medium that seems entirely different from air. But air, too, has weight and substance, and is attracted by gravity toward the earth. A barometer simply weighs air. As moist air rises, it moves spirally, usually in the opposite direction to the hands of a clock, carrying with it moisture which it has gathered from various sources, the earth, vegetation, and bodies of water. When moisture laden air rises, the barometer falls, because the atmospheric pressure is less. We speak of an area in which this condition exists as an area of low pressure. When the clouds develop rain, the air becomes heavier and descends, and the barometer accordingly rises, from the increased weight, a sign of pleasant weather.

We accept these elementary facts of physics as a matter of course. But recently, investigation of water has proved comparable in significance to the investigation of energy.

We speak of H_2O as water, yet water has none of the properties of either hydrogen or oxygen. We can separate water into these two elements, hydrogen and oxygen, by electrolysis, but when we mix hydrogen and oxygen in

the same proportion, merely a mixture of the two elements is formed, which is not water and has none of the properties of water. What is the unknown element that is necessary to convert hydrogen and oxygen into the compound we call water? Perhaps some catalyst is needed to enable these two elements to combine and release the excess free energy which this mixture may contain. We know of the tremendous heat developed by the oxyhydrogen burner and gas engine, and that if the water vapor is collected and condensed, liquid water results. The scientist cryptically states that it is only when the chemical inertia of the mixture is overcome by disintegration of the molecules, so that free atoms of hydrogen and oxygen can come into contact with each other, that water can be formed. Words—words. If we were to combine any considerable quantity of hydrogen and oxygen, it would be only with great peril from the explosion.

It is interesting that in some parts of the world where water used to be abundant, from 35 to 75 feet below the surface, and pumped up for irrigation, wells 700 feet or more deep are now necessary to reach water, and then salt water may come in. Since rainfall in these places has decreased from an average of 15 inches to 5 inches, the reserve of water in the earth has been reduced. What connection, if any, is there between water in the superficial earth and rainfall? Why did Babylonia disappear in the sands? Was the withdrawing of water from the outer earth crust for irrigation a factor?

The question arises, when is water not water as commonly considered? And the importance of this question is shown by a study of water in the presence of the colloids. We are not so sure now that the colloids always contain water in the form that we have understood it. Water is practically incompressible, yet a percentage of water, so called bound water, taken

into the body animal or plant condenses it self to 75 per cent of its former volume

W J MAYO

BARBITURIC ACID AND ITS DERIVATIVES

BARBITURIC acid and its derivatives which are used so universally today and about which so much has been written since Zerkas and McCallum called attention to their possible anæsthetic properties in February of 1929 have proved with our experience of the last two or three years to be a disappointment as a new general anæsthetic. To realize this however is not to underestimate the advantage of the drug or to slight its contribution as a new hypnotic to the comfort of the surgical patient. As a pre-anæsthetic the proper amount given in small doses by mouth or intravenously beginning twelve to fourteen hours before the maximum physiological effect is desired will probably give more satisfaction than any other drug except opium that has been used for years. To relieve a nervous high strung sensitive patient of a sleepless night with only partial remembrance of the trip to the operating room and of the first day after operation is to lift from him a terrific nervous strain which probably few of us comprehend. The drug is not particularly indicated in debilitated or elderly people nor should it be given to patients with respiratory obstruction. Patients with a very high or a very low blood pressure being poor risks should not be subjected to an additional drug.

The use of the drug in obstetrics are increasing. Apparently in labor it is more commonly given by the oral or rectal route. There is some increase in the use of the drug in the toxæmias of pregnancy. Intravenously administered it is apparently of value in eclampsia it will control convulsions and

seems to have a beneficial effect on the course of the disease. Data concerning this use of the drug is accumulating very slowly. Undoubtedly in this use of the drug dosage should be carefully judged and very cautious administration should be made in the presence of oedema.

In neuropsychiatry the use of the drug is *travencously* rapidly increasing. Psychiatrists state that it produces rest in the psychoses and quiet in the manias and that in manic depressive and involutional states and catatony it often produces a period of lucidity during which psychogenic mechanism may be studied. These psychically inaccessible patients often become much more cooperative and the period of lucidity often allows the institution of standard psychotherapeutic measures on a rational basis.

In angina and anginoid states it seems that the product is often peculiarly effective. However little has appeared in the literature along this line and judgment is pending as to this use of the drug. Recently it has been successful in controlling various spasmodic states. As an ordinary hypnotic it is excellent because of the absence of after effects.

It may be mentioned that the excessive initial doses—18 to 25 grains—which some surgeons used for a long time appear to have been entirely discontinued.

Barbituric acid is not a new drug but was synthesized by Finck in 1864. In 1888 East who was working with the so called sulphonal derivatives accidentally discovered that they possessed hypnotic qualities. In the study of the hypnotic qualities of sulphonal Fisher and von Mering noted that the hypnotic action depended on the attachment of ethyl radicals to the central carbon atom and that there was a relationship between the number of ethyl radicals so linked and hypnotic qualities. In 1903 these workers successfully completed

synthesis of the nitrogen containing drug. This product was called "Veronal" and has later become known more appropriately as barbital. Concerning the name "Veronal," there are a number of legends, one of which states that it was named after the city of Verona, Italy, and bears no particular meaning. Doctor Fisher's son has stated that the name originated from the Latin word "verus" or "true" and that his father considered that the product was probably a true hypnotic.

The recent clinical endeavor to find an ideal anæsthetic has been successful in placing a valuable drug before the profession as a pre-

liminary hypnotic. Opposing this opinion there are some surgeons in this country who question the advisability of such preliminary hypnotic agents. These men believe that continued clinical observation will fail to substantiate the advantages of the drug with which many of us are now impressed. However, the fact that so many measures have been attempted to secure preliminary hypnosis makes very evident the demand for a reliable agent. At present it would seem that the barbiturates now claiming so much attention are the most dependable agents we have.

J. TATE MASON

MASTER SURGEONS OF AMERICA

GEORGE E. GOODFELLOW

CARLYLE defined history as the essence of innumerable biographies. Such a definition may not find favor with historians but there is nevertheless in all human hearts the element of hero worship. The history of what man has accomplished in this world is at bottom the history of the great men who have worked there. The history of medicine finds its lure in the study of the lives of those men who contributed to its development.

Dr. George E. Goodfellow has won a lasting niche for himself in the illustrious pantheon of medical science alongside the master surgeons of America chiefly through his contribution to the surgery of the prostate gland.

He was born in Downieville, Sierra County, California, on December 23, 1855, where his father, Milton J. Goodfellow, had settled after crossing the plains with a train of oxen teams and covered wagons in 1849. His early life was spent in California and Nevada. At the age of twelve he was sent east to school, returning home in 1869. He attended the California Military Academy in Oakland and the University of California. He had a strong leaning toward naval and military life and was appointed to Annapolis at sixteen. While there it seems that one of the upper classmen was insulted by a plebe (freshman) and being of powerful build and impetuous courage, George was elected to fight for the honor of his class. His opponent, fresh from the plow and hard as nails, gave him a hard battle but George emerged victorious and his opponent required hospitalization. As a result of this escapade, George was court-martialed and suspended or dismissed from the academy. He then became interested in the study of medicine with his cousin, Dr. T. B. Lashells, an eminent surgeon practicing in Pennsylvania. Graduating from Cleveland Medical College (University of Wooster) with honors in 1876, he first practiced in Oakland, California, for some months, then went to Prescott, Arizona, to take over the mining practice at a large mine of which his father, a mining engineer, was then in charge. This, together with outside work, gave him a large field for surgery. His love of military life was still strong within him for he became a contract surgeon at Whipple Barracks near Prescott and at Fort Lowell. He secured permission to join General Custer but the documents from Washington were delayed and thus no doubt he was spared to do other things.



GEORGE E GOODFELLOW
1855-1910

His next move was to the then flourishing camp in southeastern Arizona, called Tombstone, the apotheosis in wickedness and lawlessness of all the famous old mining towns of the far west. Here he remained until 1892 when he removed to Tucson to take the position as surgeon with the Southern Pacific Railroad.

Dr Goodfellow put much time and thought into the matter of gunshot wounds. In this wild and lawless frontier country he had a wealth of material, because disputes were frequent and were generally settled with the revolver. It usually took heroic efforts to save the fellow who had absorbed a slug from a "forty-five," but his skill and experience won him such a reputation throughout the southwest that duellists frequently stipulated that he be within calling distance. However, it was an everlasting disappointment to him that he was never able to save the life of a person shot through the abdomen by a forty-five caliber Colt, the little ornament worn by so many frontiersmen in those days. He, himself, always carried one as a part of his wearing apparel, and emerged victorious from more than one shooting episode. He was as dexterous with the revolver as with the scalpel. His courage was of the desperate type which knew no fear. That period of our history in which he was a prominent figure is well told in two thrilling narratives *Tombstone*, by Walter Noble Burns, and *Heldorado*, by William Breakenridge.

In the position of coroner, he was called upon to examine the dead as well as to treat those who might survive in a shooting episode. As a result of "assessment work" on the remains of an unfortunate gentleman who had been badly shot up he found the body, "rich in lead, but too badly punctured to hold whiskey." Dr Goodfellow had ample opportunities to study the phenomena of shock. He recites an instance where a bullet, after passing through Morgan Earp lodged in the thigh of an innocent bystander. The latter died. "His injury," said Doctor Goodfellow, "was inconsequential and hardly more than an abrasion. Technically he died from shock. The simple fact is the man was scared to death." His work was not alone confined to traumatic surgery, but he was called upon to do everything from cataracts to abdominal sections, often under the most difficult conditions on kitchen tables far out in the country with little in the way of facilities except his own boldness and initiative. He took great pride in his surgical dexterity and went to great lengths to develop it. He was not content with following in the footsteps of others, but thought deeply and performed valuable researches, which unfortunately were lost along with a library of rare and valuable books which he had collected. However, the *Index Medicus* contains references to a number of articles published by him on a variety of topics. He made frequent trips to eastern centers to advance his surgical knowledge. By a curious coincidence his reputation for skill spread into Mexico. He was a student always, not only of his profession but of languages, several of which he learned to read and speak fluently. Philosophy was another of his interests, but geology he loved next to surgery, a hobby which led him to organize and conduct a party of scientists

into Mexico after a big earthquake about 1887. There far into the interior of Sonora he found maimed victims and did all in his power for them. The Mexican Government recognized him and presented him with tokens of esteem.

Like Edna Ferber's hero in *Cimarron* when the Spanish American War broke out this adventurous frontiersman always in the vanguard went as aide to General Shafter with the post of surgeon on his staff and the rank of colonel. He was active in all the fighting of Spaniards and disease from Siboney to Santiago. Then when the time came for negotiations for the surrender of the city and all the Spanish Army it was found that of all the members of General Shafter's staff Dr. Goodfellow was the only one who was a complete master of Spanish. As a consequence the negotiations were turned over to him. It is said that his tact and knowledge prevented the spilling of much unnecessary blood. He suffered from dysentery contracted in the Cuban campaign but on recovering came to San Francisco where he remained for eight years and quickly established a lucrative surgical practice. His scintillating surgery rapidly made him the cynosure of all eyes among his colleagues. He was noted for his epigrammatic sayings one of which was "A surgeon should have the eye of an eagle, the heart of a lion, and the touch of a woman. Your mission in life is to relieve, not to cause suffering and pain." One might say that this paraphrases the ancient aphorism of Gui de Chauliac: "Let the surgeon be well educated, skillful, ready, and courteous. Let him be bold in those things that are safe, fearful in those that are dangerous, avoiding all evil methods and practices."

It was during his sojourn in San Francisco that Dr. Goodfellow developed his operation of prostatectomy. Young in Keen's *Surgery* gives him credit for priority in first successfully performing the operation of prostatectomy. Hamer in his presidential address before the American Urological Association in 1929 stated:

The published record indicates that median penneal prostatectomy was first performed by Watson in 1889, Wishard in 1890, and Goodfellow in 1891. Each of these three operated without knowledge that it had been previously done. It does not lessen Goodfellow's achievement that he must share priority with men who worked independently and co-incidentally. He was among the first to use spinal anesthesia and to advocate the open air treatment for tuberculosis.

Dr. Goodfellow's restless adventurous frontier spirit could not long brook the restraints of city life, so in 1906 after the San Francisco earthquake and fire catastrophe he chose to go back to Mexico, urged by his intimate friend, Colonel Randolph, as surgeon in chief of the Southern Pacific Railroad of Mexico to establish the hospital system there, his charge going south to Mazatlan and east to El Paso. While thus engaged he was seized with multiple oeruntis and after a lingering illness died in Los Angeles on December 7, 1910. Thus came to a premature end the life of a man whose meteoric career was filled to overflowing with romance, glamour, and useful accomplishment.

THOMAS E. GIBSON

EARLY AMERICAN HOSPITALS

THE NEW YORK HOSPITAL

FREDERICK CHRISTOPHER, B S, M D, F A C S, EVANSTON, ILLINOIS

Assistant Professor of Surgery Northwestern University Medical School Attending Surgeon Evanston Hospital House Surgeon New York Hospital 1917

*Homines ad Deos, nulla re propriius accedunt,
quam Salutem Hominibus dando—Cicero¹*

THE history of a great institution is but little concerned with bricks and mortar, rather does it deal with the many personalities whose enthusiasm, high purpose, and generosity have made it possible. Since its foundation over one hundred and sixty years ago the New York Hospital has been particularly rich in splendid men and women whose intelligent zeal and generosity have worked mightily to alleviate the sufferings of the over two million patients treated there in that time.

In the year 1769, the twenty thousand population of New York City was not served by a hospital. The so-called "City Hospital" of this time scarcely deserved such a designation for it was merely a room thirty-five by twenty-three feet containing six beds. A hundred years previously a primitive institution under the supervision of a Dutch matron had existed for a few years. In fact, at this time, the Pennsylvania Hospital which had opened seventeen years previously through the efforts of Doctor Thomas Bond and Benjamin Franklin was the only hospital in existence in the American Colonies.

The antagonistic feelings of the colonies toward England was more or less quiescent in this year. The Stamp Act had been repealed and the conciliatory Sir Henry Moore, Bart, was "Captain General, and Governor in Chief, in and over the Province of New York, and the Territories depending thereon, in America, Chancellor and Vice-Admiral of the same."² It was a particularly fitting time for the appearance of Samuel Bard.

Son of the eminent John Bard, who in 1759 performed one of the earliest successful operations on a patient with an ectopic pregnancy, Samuel

Bard was sent abroad for his medical education. Captured by the French and held prisoner for five months he was finally released through the efforts of Benjamin Franklin, his father's friend. In London he studied under Fothergill and Hunter, of St Thomas' Hospital, and in September, 1762, proceeded to Edinburgh, then a medical school of highest repute. Three years later he was granted the degree of M D and after further study returned to New York. In 1767 the Medical School of King's College (Columbia), the first medical school in New York City, was established "largely through the zeal and devotion of Doctor Samuel Bard"³ who was made the professor of the practice of medicine.

To posterity, perhaps, the most dramatic moment in Samuel Bard's career was his "Discourse upon the Duties of a Physician, with some Sentiments on the Usefulness and Necessity of a Public Hospital,"⁴ which was delivered in Trinity Church on the occasion of the presentation of degrees to the first two graduates of King's College Medical School. On this day, May 16, 1769, Samuel Bard, who was then but twenty-seven years of age, delivered before Sir Henry Moore and a notable gathering, his eloquent plea which led to the founding of the New York Hospital. He said in part "Let those who are at once the unhappy Victims, both of Poverty and Disease, claim your particular attention, I cannot represent to myself a more real object of Charity, than a poor Man with perhaps a helpless Family, labouring under the complicated Miseries of Sickness and Penury. Paint to yourselves the agonizing feelings of a Parent, whilst labouring under some painful Disease, he beholds a helpless Offspring around his Bed, in want of the necessities of Nature, imagine the Despair of an affectionate Wife, and a tender Mother, who can neither relieve the Pain and Anxiety of her Hus-

¹Garrison F. H.

²New York. Printed by A. and J. Robertson at the corner of Beaver Street 1769. Reprinted 1921 by the Columbia University Press New York.

³There is nothing by which a man approaches nearer to the perfections of the Deity than by restoring the sick to the enjoyment of the blessings of health. Quoted by Samuel Bard in his Discourse at King's College May 16 1769.

⁴Title as given in preface to Samuel Bard's Discourse.

South Building, and a laundry, extensive stables, and a building for lectures and autopsies occupied other sites. The structural group which contained about five hundred beds for patients, continued in active use until 1870, when the governors of the Society found the financial burden of maintaining a hospital on that spacious and valuable site too heavy to bear. They accordingly vacated the buildings and leased the ground on long terms, which have, from time to time been renewed. As soon as the necessary funds could be accumulated, a new hospital was built on the present site in Fifteenth and Sixteenth Streets, west of Fifth Avenue, and there the work of the Society's General Hospital has since been conducted."¹⁰

Many brilliant medical figures were concerned with the New York Hospital. Richard Bayley was appointed Surgeon in 1792 and served for thirteen years. Bayley, the first professor of anatomy at King's College, was a celebrated surgeon and probably the first to disarticulate the arm at the shoulder. Next may be mentioned the great professor of surgery at King's College, Wright Post, who served the New York Hospital as surgeon and consulting surgeon for thirty-six years. Post was a pupil of John Hunter and was the first in this country to ligate the subclavian artery above the clavicle and to ligate successfully the femoral artery for popliteal aneurism. He ligated the common carotid artery in 1813, and the external iliac artery in 1814. Valentine Seaman was appointed surgeon in 1796 and served for twenty-one years. In addition to his distinction from initiating instruction of nurses, to be referred to below, Seaman employed vaccination against small pox at the New York Hospital for the first time in America. In 1800 he published the alliterative "Midwife's Monitor and Mother's Mirror." The distinguished Samuel L. Mitchell was appointed physician in 1796 and served for twenty-one years, so great was his learning that John Randolph referred to him as the "Congressional Library." David Hosack served, in all, thirty-four years as physician and consulting physician. He was known to be particularly successful in his treatment of yellow fever and to have treated hydrocele by injection



VALENTINE MOTT
1785-1865

In 1797 he was professor of materia medica at Columbia, in 1807 professor of surgery and midwifery at the College of Physicians and Surgeons, New York. James S. Stringham appointed physician in 1807 was the earliest professor of medical jurisprudence in America.

The next great personality was Valentine Mott, who was appointed Surgeon to the New York Hospital in 1817 and served in that capacity and as consulting surgeon for forty-eight years, dying in office in 1865. Mott studied under Sir Astley Cooper in London and also at Edinburgh. At twenty-four years of age "feeling the competency of genius"¹¹ he succeeded in obtaining permission from the trustees of Columbia College to give private lectures in operative surgery and two years later was appointed professor of surgery at this institution. In 1818 Mott ligated the innominate artery for the first time in the history of surgery (Garrison).¹² Sir Astley Cooper said that "He performed more of the great operations than any man living. Many a time was he called upon to perform at midnight by the flickering aid of a candle, operations not only difficult in themselves, but dangerous to the patient and without any assistance than that of excited relatives or ignorant friends."¹²

In 1930 a most interesting book entitled "Surgery at the New York Hospital One Hundred Years Ago" was published by Pool and McGowan.¹⁴ These authors have found a note book entitled, "Surgical Register. Surgical cases selected from among patients in the wards of the New York Hospital according to the Third Section of the Ninth Chapter of the By-laws and Regulations of the Hospital." In this book the house surgeons recorded the unusual cases from 1808 to 1833. In case eighty-two of this book the patient died from a rupture of the liver with tremendous intra-abdominal hemorrhage as revealed by postmortem. The record says "He had been bled before he came into the house, his pulse at his admission was weak and irregular ten o'clock

¹⁰Kelly Howard A. *Cyclopedia of American Medical Biography* Philadelphia W. B. Saunders 1912 p. 200

¹¹Mott. *Medical and Surgical Register* New York 1818 p. 54.

¹⁴*Surgery at the New York Hospital One Hundred Years Ago*. Pool Eugene H. and McGowan Frank J. New York: Paul H. Hoeber Inc. 1930

recent times, before being appointed house surgeon or house physician a man must serve eighteen months on the surgical or medical service respectively. The list includes many celebrated surgeons past and present among them William S Halsted, later the famed professor of surgery at Johns Hopkins who was house physician 1878, Ellsworth Eliot, Jr., William B. Coley, Charles H. Peck, Edward L. Keyes, Jr., Alfred S. Taylor, William A. Downes, Adrian V. S. Lambert, Eugene H. Pool, James M. Hitzrot, and others.

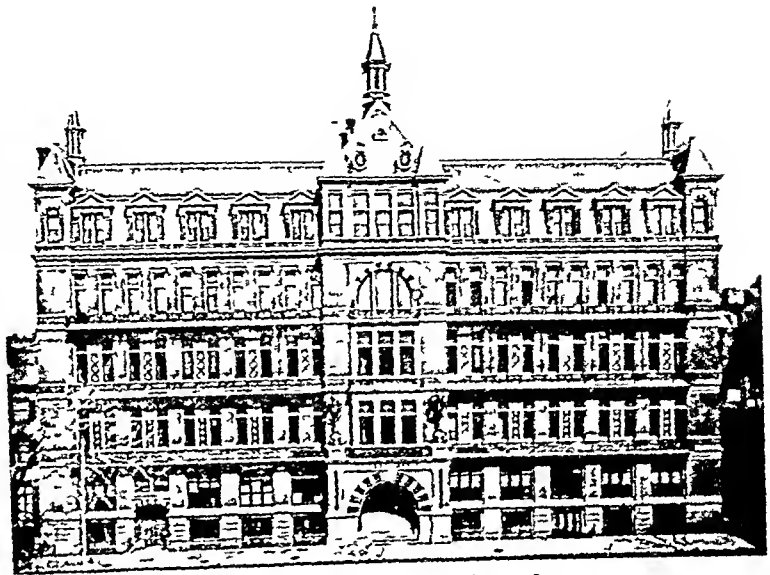
According to Nutting and Dock¹⁷ "the distinction of having made the first attempt to teach nurse attendants belongs to the New York

Hospital, and to Dr. Valentine Seaman, one of its medical chiefs, a remarkably broadminded man, is due the honor of having conceived and initiated the first system of instruction to nurses on the American Continent. It was not until May, 1877, that the Governors of the New York Hospital founded the Training School for Nurses." It was "the first private Hospital training school in the city"¹⁸, the Bellevue Hospital Training School having been established four years previously. Since that time over twelve hundred women have graduated and over three hundred of these subsequently have served as instructors in other institutions. Miss Irene H. Sutcliffe was a noted directress of nurses from 1886 to 1902.

Many of New York's most distinguished and influential citizens have served on the Board of Governors of the New York Hospital. John Jay, the first Chief Justice of the United States served from 1787 to 1789, Roger Morris from 1770 to 1773, and from 1777 to 1784, John Watts from 1777 to 1784, Dr. John Fothergill of London from 1770 to 1774, Aaron Burr from 1784 to 1792, John Adams from 1818 to 1854, John Jacob Astor from 1860 to 1864, Cornelius N. Bliss from 1885 to 1899 and from 1901 to 1908, Joseph H. Choate from 1877 to 1917, George F. Baker from 1899 to 1931, and Payne Whitney from 1912 to 1927.

¹⁷Nutting, M. A., and Dock, L. L. A History of Nursing. New York: G. P. Putnam's Sons, 1907. p. 339.

¹⁸Sheldon, Edward W. Address at Exercises Commemorating the Fifty Years of the New York Hospital School of Nursing.



New York Hospital, building used from 1877 to 1932

In 1821 the New York Hospital established on Morningside Heights the Bloomingdale Hospital for mental diseases, which in 1894 was moved to White Plains and now cares for over five hundred mental cases. The branch hospital, the House of Relief, was maintained from 1875 until 1919 when it was sold to the United States Government. The Campbell Cottages for Convalescent Children was founded at White Plains in 1907 and now takes care of over seventy children daily. Since 1877 the New York Hospital has maintained an ambulance service and since that time has responded to over 245,000 ambulance calls.¹⁹

From the time the first wounded American soldiers were admitted to the New York Hospital in 1776, it has always played an important part in war service. During the war of 1812 the blockading British fleet accorded permission for the passage of a coal ship so that adequate fuel could be obtained for the hospital which cared for soldiers and sailors. In the Mexican war a few soldiers were treated at the hospital but during the Civil war some three thousand soldiers were given medical and surgical attention. During the Spanish-American war several hundred soldiers were given free treatment. During the World War the New York Hospital maintained United States Base Hospital Number 9 at Chateauroux, France, where fifteen thousand medical and surgical cases were cared for (Sheldon¹⁹).

¹⁹Christopher Frederick. Notes on One Thousand Three Hundred Ambulance Calls in New York. J. Am. M. Ass., 1917, 1918, 1919.

Since 1901 when the medical students of Kings College were given clinics and instruction in the New York Hospital it has taken an active part in medical education. In 1867 the hospital received the medical students of the College of Physicians and Surgeons. The present medical school affiliation is with the Medical College of Cornell University. The large charitable service has afforded abundant material for instruction. The hospital is supported by means of its endowment fund and by the receipts from its private patients and it has always maintained its separate identity.

And now the Governors of the New York Hospital have built a new home which adequately should provide for the next one hundred years. It is situated on an area of three city blocks along York Avenue between Sixty eighth and Seventy first Streets. On the east is the East River and on the South the grounds of the

Rockefeller Institute for Medical Research.

When opened in the fall of 1931 the project will provide approximately one thousand beds for patients and correspondingly ample facilities for treatment of out patients. There will be living quarters for approximately one hundred and twenty five resident doctors, five hundred nurses and two hundred employees. Instruction will be provided for about three hundred undergraduate medical students and for many advanced students.⁶ The medical school affiliation will be with the Medical College of Cornell University.

When one considers what one hundred and sixty years have done for the New York Hospital it seems that the acme has been attained. But imagination and conjecture can scarcely cope with the surmise as to the nature of the historians writing one hundred and sixty years hence.

Physiology and the Histology of the New York Hospital

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE first number of the *Cleveland Clinic Quarterly* dated January, 1932, reprints articles by members of the Clinic staff that have been published in various journals, together with case reports and presentations made at regular staff meetings. The purpose of the *Quarterly* is to furnish in convenient form reprints of all published papers originating at the Clinic and thus "avoid the disadvantages both to the senders and the recipients of sending separate reprints." The first number contains several interesting articles: "The Nature of Living Cells," George W. Crile, Maria Telkes, and Amy F. Rowland, "Silent Lesions of the Upper Urinary Tract," William E. Lower, "Types and Treatment of Chronic Rheumatism," Russell L. Haden, "The Location of Metastases from the Urinary Tract, the Prostate, and the Thyroid Gland," B. H. Nichols, "Prognosis and Treatment of Malignant Goiter," Robert S. Dismore, "Riedel's Struma in Contrast to Struma Lymphomatosa," Allen Graham, "Sacral Chordoma," James A. Dickson and C. A. Lamb, "W. C. Roentgen and the Discovery of the Roentgen Rays," Otto Glasser, "A Case of Traumatic Retrobulbar Arteriovenous Aneurysm," W. James Gardner and W. B. Hamby, "Gastrojejunocolic Fistula," John C. Jones. M. L. Mason

PAGET'S collection of philosophical essays¹ was originally published 13 years ago and has just been reissued. The essay on Ambrose Pare is particularly interesting and refreshing, that on "Vocation" is thoughtful and valuable, and those on "Hospital Life" and "Practice" will be read with sympathetic appreciation by internes and practitioners. The following quotation is illustrative:

"But the young doctor, the new doctor, in a gossip house, must never be off his guard. He has seen and prescribed for his patient, and has said all that need be said to the friends, and there is tea, and what seems a favourable opportunity for extending practice. Trust them not, young man, put your fingers in your ears, and flee from the City of Destruction of Reputations. If you must stay, do not stay long, and keep the door of your lips. Talk of the patient, of the weather, or of the proposition, which will as surely as the bread-and-butter be handed to you, that *There is a good deal of illness about*. Avoid all topics of Church and State, quote neither poetry nor prose, give neither censure nor approval to music and the drama, hide your liking

for any art but your own. Leave behind you, for gossip to lap, a saucerful of the milk of human kindness. Never mind about producing a favourable impression, produce this one impression, that you know your work, and that it will not be your fault if the mixture fails to relieve the patient upstairs and then flee."

FREDERICK CHRISTOPHER.

THE third volume of a series of handbooks on therapy and clinical radiology published under the general editorial supervision of Prof. Guido Holzknecht,² whose recent death the whole medical world mourns, has been published.

The work is one concerning which superlative adjectives may be honestly used. It is really the outstanding and most complete work on radiology of the oesophagus which has ever been published. Its completeness and thoroughness really should serve, for some years to come, to dampen the ambitions of any one else considering a work on the radiology of the oesophagus. Chapters are included on the anatomy and physiology of the oesophagus, with special reference, of course, to those facts which have bearing on the radiological interpretation.

A chapter is devoted to the normal oesophagus. In the second section we find descriptions of the pathological changes of the oesophagus as seen roentgenologically, a detailed description of the functional and organic diseases of the oesophagus, a section is devoted to foreign bodies and oesophageal changes secondary to diseases of neighboring organs, the operated upon oesophagus, and the aid of the X-ray in therapeutic endeavors in oesophageal disorders. The third portion of the book is devoted to radiotherapy of the oesophagus, which, of course, means practically the use of radium and X-rays in oesophageal carcinoma. Interpretation and technique are discussed in detail, both for radium and the X-ray therapy and for the combined use of these two methods. Peptic ulcer of the oesophagus is the only lesion aside from cancer which seems to have responded somewhat to radiotherapy.

JAMES T. CASE.

THE authors express in the preface of their work³ on laboratory technique the hope that this vol-

¹HANDBUCH DER ROENTGENKUNDE. Edited by Guido Holzknecht. Vol. II. ROENTGENUNTERSUCHUNG UND STRAHLENBEHANDLUNG DER SPELEROEHRE. By Dr. Josef Palko. Vienna: Julius Springer 1931.

²APPROVED LABORATORY TECHNIC. CLINICAL PATHOLOGICAL, BACTERIOLOGICAL, SEROLOGICAL, BIOCHEMICAL, HISTOLOGICAL. Prepared under the auspices of the American Society of Clinical Pathologists. By John A. Kolmer, M.D., Dr. P.H. D.Sc., LL.D., and Fred Boerner, M.D., assisted by C. Zent Garber, A.B., M.D. New York: D. Appleton and Company 1931.

³CONFESSIO MEDICI. By Stephen Paget, F.R.C.S. New York: The Macmillan Company 1931.

Since 1791 when the medical students of Kings College were given clinics and instruction in the New York Hospital it has taken an active part in medical education. In 1807 the hospital received the medical students of the College of Physicians and Surgeons. The present medical school affiliation is with the Medical College of Cornell University. The large charitable service has afforded abundant material for instruction. The hospital is supported by means of its endowment fund and by the receipts from its private patients and it has always maintained its separate identity.

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Published by the New York Society of the History of Medicine

Contrary to previous work, Dr Pelouze is inclined to believe that there is only one strain of gonococcus. His contention that it is rare to hear complaints from the patient with acute gonococcal prostatitis cannot be supported. Except for alcohol he places no restrictions on diet. All oral medication has little value. Diathermy is absolutely ineffective in the treatment of gonorrhoea. A timely plea is made to use vaccines in small doses. All patients are advised to use condoms for at least 3 months after they are pronounced cured.

Dr Pelouze believes that the incidence of true gonococcal seminal vesiculitis is small. He gives a concise discussion of the nature and examination of prostatic fluid. Epididymitis is a truly mechanistic toxin infection from a distended seminal vesicle down the vas. The surgical treatment of gonococcal epididymitis is not favored.

The case studies have not been altered much and are yet too overdrawn to convey to the practitioner anything except respect for correct diagnosis and a horror of overtreatment.

The author advises no local treatment of any parts of the female during the acute and subacute stages of gonococcal infection, when the disease has become chronic, active treatment with mild topical germicidal solutions may be instituted. Such a plan is supposed to obviate complications.

This book is a valuable and useful addition to the library of any doctor.

HARRY CULVER

AN exhaustive and detailed account of hydrotherapy, thermotherapy, and roentgenotherapy

in gynecology is given in the first half of the fourth volume of Veit's handbook¹ on gynecology. The text is well written but there is very little new in the subject matter that is not ordinarily found in textbooks devoted to hydrotherapy, thermotherapy, baths, and electrotherapeutics.

Too much emphasis is placed on the values of the types of baths (dry and moist heat), douches, massage, and mechanical therapy. In the section on roentgenology more than 175 pages are devoted to the development and types of X-ray apparatus, most of which have been replaced to a great extent by the more modern improvements. Much of this detail could be safely omitted and more space devoted to the subject of roentgenotherapy.

It is striking that the American unit which is standardized by the U. S. Bureau of Standards is not mentioned, although much space is devoted to the German, French, and international units (r-Einheiten). To the clinical gynecologist it is most urgent that a universal standard be adopted or a ratio of the r-units be established so that one may be able to evaluate the various results recorded in treatment.

In spite of these criticisms, there is no doubt that the completeness of the subject matter and the true German thoroughness with which they are covered, renders this volume of unusual value to gynecology.

SYDNEY S. SCHOCHET

JULIUS E. LACENER

¹ VEIT'S HANDBUCH DER GYNEKOLOGIE. Edited by Dr. W. Stoeckel. Vol. IV, 1st half—DIE PHYSIKALISCHE THERAPIE IN DER GYNEKOLOGIE. Edited by A. Laquer, W. Rump and H. Wintz. Munich: J. F. Bergmann, 1930.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

PATHOLOGIE UND KLINIK IN EINZELDARSTELLUNGEN. Vol. 11—Thrombose, ihre Grundlagen und ihre Bedeutung. By A. Dietrich. Berlin and Vienna: Julius Springer, 1932.

UNITED STATES ARMY X-RAY MANUAL. Authorized by the Surgeon General of the Army. 2d ed. Rewritten and edited by Lt. Col. H. C. Pillsbury, M.C., U.S.A. New York: Paul B. Hoeber, 1932.

THOMSON & MILES' MANUAL OF SURGERY. By Alexander Miles, M.D., LL.D., F.R.C.S. (Edin.), and D. P. D. Wilkie, M.D., F.R.C.S. (Edin. and Eng.). Vol. II—Extremities—Head—Neck and vol. III—Thorax—Abdomen. 8th ed. New York and London: Oxford University Press, 1931.

APPLIED PHYSIOLOGY. By Samson Wright, M.D., M.R.C.P. 4th ed. New York and London: Oxford University Press, 1931.

GYNEKOLOGISCHE OPERATIONSLEHRE. By Hofrat Prof. Dr. Josef Halban. Berlin and Vienna: Urban & Schwarzenberg, 1932.

HERTZLER'S MONOGRAPHS ON SURGICAL PATHOLOGY. Surgical Pathology of the Female Generative Organs. By

Arthur E. Hertzler, M.D. Philadelphia, Montreal, and London: J. B. Lippincott Company, 1932.

SURGICAL ERRORS AND SAFEGUARDS. By Max Thorek, M.D. With a Foreword by Arthur Dean Bevan, M.D. Philadelphia, Montreal, and London: J. B. Lippincott Company, 1932.

TEXTBOOK OF GYNECOLOGY. By Sidney Forsdike, M.D., B.S., F.R.C.S. London: William Heinemann, 1932.

FERTILITY AND STERILITY IN MARRIAGE, THEIR VOLUNTARY PROMOTION AND LIMITATION. By Th. H. Van de Velde, M.D. Translated by F. W. Stella Browne. New York: Covici, Friede Inc., 1931.

SAN FRANCISCO CANCER SURVEY, SEVENTH PRELIMINARY REPORT. By Frederick L. Hoffman, LL.D. Conducted under the auspices of the John Hancock Mutual Life Insurance Company, The Pacific Mutual Life Insurance Company, and The Prudential Insurance Company of America.

AN INTERNATIONAL ENQUIRY INTO COSTS OF LIVING, A COMPARATIVE STUDY OF WORKERS' LIVING COSTS IN DETROIT (U.S.A.) AND FOURTEEN EUROPEAN CITIES. International Labour Office Studies and Reports Series N (Statistics) No. 17. Geneva, 1931. London: P. S. King & Son, Ltd., 1931.

THE GENIUS OF LOUIS PASTEUR. By Piers Compton. New York: The Macmillan Company, 1932.

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SENDER TO THE EDITOR: I have received your letter of the 10th inst. and am glad to hear that you are interested in the book. I have no objection to your using it for your own private use, but I cannot give you a license to use it for any other purpose. I am, Sir, very respectfully,
Yours truly,
J. P. St. n

second assistant to familiarize himself at the operating table with the pathological conditions from which his patients suffer and the methods taken to relieve the conditions. He should learn more about operations and particularly the dangers of operations and the complications that ensue therefrom. Finally, in this year he should be made to conduct the administration of the anæsthetic in a certain number of cases, for one of the sorry sights in modern medicine is to find physicians who really are incapable, even in an emergency, of giving an anæsthetic satisfactorily.

ACTUAL CURRICULUM REQUIREMENTS IN HOURS

Second year

Lectures—8

Laboratory exercises—about 100 hours

Third year

Weekly lectures—32 hours

Weekly clinic—32 hours

Section work—about 100 hours

Surgical specialties—each 8 lectures and 25 hours in dispensary section work—X-ray, genito urinary surgery, orthopedic surgery, ophthalmology, otolaryngology

Fourth year

At least 2 months as clinical clerks

GRADUATE TEACHING OF SURGERY¹

GEORGE J. HEUER, M.D., F.A.C.S., NEW YORK

IT has been rather difficult to know just how to approach the subject of the graduate teaching of surgery. In a broad sense graduate teaching in one form or another is widespread in this country. Any hospital, clinic, or other organization, whether connected or not with a recognized teaching institution may and does conduct so-called graduate courses in surgery. Some of these hospitals and clinics have been approved by the Council on Education of the American Medical Association or the American College of Surgeons, and their courses, therefore, are known to possess some merit. The majority, I imagine, have not received such recognition and their courses and the quality of instruction given remain obscure. It is impossible for an individual to know at first hand what is going on in this field of graduate teaching and therefore fairly to appraise it. In a narrower sense, graduate teaching may be considered a function of the university medical schools and discussed from this viewpoint alone, and with the hope that such a discussion might provoke a more lively interest in the subject than has been evident in the past. This might be the better and easier avenue of approach, for it is known, or easily could be ascertained, what particular problems each medical school has to meet, how it may or has met them, and what results it thus far has achieved. Neither of these avenues of approach, to me, seems satisfactory for this occasion, for the time obviously is too short to discuss the various aspects of the subject. I propose, rather, to present the subject from the viewpoint of the many graduates in medicine who each year seek opportunities in surgery, a view-

point I believe I have interpreted correctly as a result of the experience gained by many years of graduate teaching, of the investigation of many clinics where graduate teaching is done, and of the information acquired by interviews with and letters from hundreds of young men who have desired a career in Surgery.

These men comprise in general three groups of individuals: (1) those who, following their graduation in medicine, wish to and can at once pursue their graduate studies, (2) those, who, having taken a graduate course in surgery of 2 or 3 years' duration, have found it inadequate and seek further education and training, or who, having spent one or more years in a laboratory or other branch of medicine decide upon a surgical career, and (3) those who having gone into the practice of surgery for a variable period decide that their education is incomplete and wish either to start anew or to supplement their education. The opinions of these men who live in all parts of the country and who have had a great variety of experiences afford a surer guide to the status of graduate teaching in this country than any I may have formulated. Moreover, they should have more weight, for those seeking careers in surgery are numerous, know what they want, know the sacrifices involved in the attainment of their ideals, and are quite willing to make them. These opinions may, I think, fairly be stated as follows: (1) that neither the quality, nor the duration, nor the scope of the graduate instruction generally offered at present are satisfactory to those students seeking a career in surgery, and (2) that the opportunities for graduate instruction which to

¹Presented in Symposium on Graduate and Undergraduate Teaching of Surgery. Clinical Congress of the American College of Surgeons, New York, October 24, 1932.

AMERICAN COLLEGE OF SURGEONS

TEACHING OF SURGERY¹

ELLIOTT C. CUTLER, M.D., F.A.C.S., CLEVELAND, OHIO

THE real education of a surgeon is a post graduate problem. It is a matter requiring several years of experience and in this country is provided for in the posts of assistant resident and resident surgeon in the larger hospitals both with and without university affiliation. Surgery can be learned only by practice and it should not be required of the teacher of surgery in any school to turn out people qualified to practice this dangerous art. In fact one of the highest obligations still resting upon the profession of medicine is to change the present registration laws which permit the graduate of any medical school who can pass the registration examination to practice surgery. At the same time since a large proportion of the general practitioner's patients suffer from disorders for which minor surgery is the chief therapeutic agent every medical school must provide its students with teaching and experience in the principles of surgery and particularly in the care of patients suffering from trauma and infection. In addition it must give its graduates sufficient teaching and practice in the giving of anesthetics to make it safe for them to administer anesthetics in time of necessity. To accomplish these aims it is customary that undergraduates be grounded in the principles of surgery. These principles are the methods by which we combat pain, infection and hemorrhage. It is well known that surgical procedures carried out without pain, hemorrhage or infection are likely to be successful provided the student has a fair knowledge of anatomy and physiology.

The block system utilized in most American medical schools provides for the study of normal structure and normal function in the first 2 years. Following this come 2 years in which students study alterations from the normal—which we call disease. In between these two great periods of the student's education should come certain preliminary courses given by the departments of medicine and surgery in which the students are taught the methods by which one studies alterations from the normal. This instruction is best given before the students see patients with the

block system used in this country this usually means at the end of the second year. Instruction in this introductory course in surgery should include some teaching in anesthesia, asepsis, surgical technique and the principles of support and immobilization. I believe that this teaching is best carried out partly by a few didactic lectures followed by some practical experience which may be best given in a laboratory. I believe that the administration of an anesthetic is more properly learned upon animals than upon human beings. I believe that asepsis and the principles which underlie sterilization as well as the practical carrying out of methods of sterilization can well be taught in a laboratory course in which the student learns to scrub their hands, sterilize their dry goods and instruments and also learn by minor procedures upon animals that operating upon living matter is somewhat different from their anatomical and pathological experiences. At the same time in this course may be taught the principles of support and immobilization which underlie the care of fractures and other forms of trauma.

In the third year the students should come into contact with patients. This is usually carried out by having students attend dispensaries and outpatient departments in small sections. At the same time by lectures and amphitheater clinics the class should cover in a general manner regional surgery. And in addition a few lectures and some descriptive practice must be given in all the surgical specialties. This year should allow the student a wide familiarity with the ordinary forms of diseases to which the surgeon may bring some relief and in particular he should learn the methods by which to care for the simple forms of trauma and infection.

Finally in the fourth year it is customary for students to be taken into hospitals associated with their medical school as clinical clerks. At this time the student is practically a junior intern. He should continue to increase his familiarity with the forms of disease usually cared for by surgeons. Here he will see more of active therapy and indeed should be permitted as

in graduate teaching continue as they are and evolve as they may in spite of the dissatisfaction of graduate students or whether, generally, we should attempt to meet their requirements. My own opinion is that we seriously should consider making the attempt, for when a time has arrived, as it seems to have at present, in which the educational ideals of a great number of students are apparently higher than those of the teachers who instruct them, our position as teachers leaves something to be desired.

The attempt certainly should not be made unless the responsibilities involved are clearly understood. To grant a graduate student a large experience in operative surgery it is necessary that he have a long period of graduate instruction. This should include a thorough knowledge of surgical pathology and of the fundamental principles of surgery, a wide experience in the diagnosis of acute and chronic surgical conditions, a familiarity with pre-operative and postoperative treatment, a large experience in operative surgery gained first as an assistant and later as an operator under the immediate guidance of his teachers, and sound surgical judgment gained not only by contact with his teachers but through his own surgical experiences. Since it cannot be foretold along which road his career may lie, it should include, in addition to this clinical training, a familiarity with the technique and methods of research, and experience in teaching and in the organization of a teaching clinic. It should lastly and importantly include the knowledge and the acquisition of the best ideals in medicine.

That such a form of graduate teaching has been in existence for many years must be well known to you. It is the form long since used in the German university clinics, it was first introduced in this country by Halsted and was in use continuously in Baltimore during his lifetime there, it has been adopted by some of Halsted's earlier pupils who have been appointed to chairs of surgery and has appealed to some of the younger surgeons, not of Halsted's particular school, who more recently have been appointed to professorial posts. Our own experiment in this form of graduate teaching is of 10 years' duration and differs from earlier ones only in some minor, but, we believe, important details.¹ The exact kind and scope of the instruction given and the experience gained in this form of graduate teaching may and does vary in the few clinics in which it exists. With us the period of instruction covers 6 years after the interne year, and at the end of this

period a graduate student's clinical experience will have included close contact with at least 10,000 surgical cases, and he personally will have performed from 1,200 to 2,000 surgical operations of which 75 per cent will have been major operations. His teaching experience will have covered 5 years in the teaching of surgical pathology, of the principles of surgery and of clinical surgery in various dispensaries and wards. His experience in organization will have included the conduct of the hospital wards, operating rooms, research laboratory, and out-patient dispensaries. His experience in research work will have included the pursuit of a varying number of clinical and experimental problems depending upon his leanings and capabilities in this direction. But, however it may vary in its details in different clinics, this form of graduate teaching has, to the student, this great advantage—that at its termination he may set out upon his career, not with the idea that his education is now complete, but with the confidence that he safely can practice surgery upon his fellows or enter upon a career of teaching and research.

This, then, is the sort of graduate instruction which young men planning a career in surgery are seeking and often seeking in vain. The form of education they want exists but exists only for the comparatively few. They have already accepted it as desirable and are willing to devote the years necessary to its acquisition. What would appear necessary for its wider adoption are the convictions on the part of university medical schools, hospitals, and surgical profession that it is sound and the facilities for properly conducting it.

That the conviction of the soundness of this form of graduate teaching is not at all general is quite evident, but I sometimes wonder whether it is a considered conviction. My attempts to survey educational literature as it pertains to the graduate teaching of surgery leads me to think that the subject has not adequately been presented to the profession at large. In the years that I have been associated with various surgical societies, the members of the majority of which are teachers of surgery, I cannot recall a meeting devoted to a discussion of the graduate teaching of surgery. So far as I know, no serious study of the results of the various forms of graduate teaching now open to the student has been made. Possibly, then, the subject has not been considered sufficiently to warrant positive convictions, and perhaps the time is ripe seriously to appraise, as our students before us, our present methods of graduate teaching.

¹ I have elsewhere described this form of graduate teaching. See Univ of Cincinnati Bull. 1951 series IV Surgery South M J 1930 xxiii, 22.

them are satisfactory at present are quite inadequate. To them proper graduate teaching in surgery is a very important need in medical education today.

For the student to find fault with our present methods of graduate teaching is of course not difficult but for us to suggest better methods which successfully can be carried out under existing conditions seems to me quite difficult. The problem is a complicated one. Involved in it is the proper education of the three groups of individuals I have just enumerated and by means of teachers and institutions which vary tremendously in almost every conceivable respect. Obviously it would be impossible to discuss such a complicated subject in 10 minutes and I shall in the time allotted me speak only of graduate teaching as it pertains to the first group—to those graduates in medicine who at once are able to pursue their graduate studies. To select this group seems to me proper for in my experience it is the most numerous and the most insistent in its demands. Moreover I think that if its demands can be met satisfactorily one of two things will happen with respect to the other groups: either they will in a comparatively few years disappear or the difficulties connected with their proper education will become clarified and therefore more easily solved.

What opportunities at present has a member of the first group of acquiring further education and experience? (1) He may find himself compelled to enter practice at once and by the experience so acquired enlarge his education. (2) he may affiliate himself with an older practicing surgeon who becomes his graduate teacher. (3) he may go abroad and make arrangements with a foreign surgeon who gives him a graduate course in surgery. (4) he may take a 1 or 2 or 3 years or 30 months internship in a hospital during the latter part of which particularly he receives some graduate instruction. (5) he may join a surgical clinic which gives a 2 or 3 years course of graduate instruction. (6) he may connect himself with a hospital and by a long apprenticeship work his way through dispensary service up to the position of assistant attending and finally of attending surgeon. and (7) he may be selected to take a period of graduate instruction and training in one of our university medical schools. The prospective surgeon's early career may therefore vary greatly. By any of the methods enumerated he may and has achieved the higher career in surgery for as in educational efforts generally the results depend not so much upon methods as upon the man seeking education or the combina-

tion of man and teacher. But in my experience the graduate student while admitting its correctness is at present wholly unimpressed by this viewpoint. He realizes as well as we that sound leadership in medicine becomes increasingly desirable as the complexity of the subject increases. He knows that in a country where each year more than a million surgical operations are performed a fairly large number of highly educated self-practitioners of surgery are necessary and no longer content with mediocrity. He is eager to be included among the leaders and best practitioners. He seeks the forms of graduate teaching which he believes will most surely lead him to his desires and he appraises them from this viewpoint.

In this appraisal the 3 first methods fail to figure largely and he takes advantage of them only when other opportunities are lacking. The fourth and fifth methods are acceptable but often are a source of keen disappointment. As graduate courses they are too short and prove to be merely preparatory courses the recipients of which require further training before they feel competent to practice surgery. Many interviews with letters from young men attest to the correctness of this statement. The sixth method—a long apprenticeship in a good hospital—has always been a favorite and has led to the production of many good surgeons. The chief objection to it on the part of the young man seeking graduate instruction is the lack of progression in his education. The men arriving at the higher positions remain too long in them; they halt the progress of younger men coming along who in turn hold up others. As a teaching unit the organization periodically becomes quiescent the only activity—and the least important from the viewpoint of graduate teaching—being the coming and going of a group of internes. The seventh method—a period of graduate instruction in a university medical school—is the most eagerly sought but again the student finds in different medical schools the greatest variations in the kind, the duration and the apparent utility of the graduate teaching of surgery. As in the other forms of graduate teaching enumerated he often fails to find what he seeks.

What he seeks undoubtedly is a thorough surgical education which includes a large proportion of the experience of surgery gained under competent teachers. He seeks in other words a surgical education on a par with its logical conclusion—not one which mit a very essential part of it—its culmination.

The question arises whether educational and practical it is better that all these experiments

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THE HISTOPATHOLOGY OF THE UTERUS IN RELATION TO THE SO-CALLED ESSENTIAL OR IDIOPATHIC UTERINE BLEEDING

MARY SPIVACK, M D, CHICAGO

From the Department of Pathology and Bacteriology University of Illinois College of Medicine

THE essential uterine bleeding is defined as that in which there is an absence of any detectable clinical pathology in the entire female genital tract, save for possible enlargement of the uterus. This affliction has been called "chronic metritis," "fibrosis uteri," "myopathia hæmorrhagica," "pseudo-metrite" (French), "sclerose uterine" (French), etc., according to the views of various authors upon the cause or chief pathological feature observed by them.

Numerous papers and monographs have been written upon the subject, a great amount of research has been done in this direction, and yet at the present time we cannot say that the precise cause of this condition is known, and as it often happens, when the etiology is obscure, numerous theories are offered in its explanation by various authors only to be disproved and cast aside by subsequent investigators. Nevertheless, the multitude of work has accomplished a great deal. It has taught us the minute histology of the female genital tract at the various phases of the woman's sexual life, it has clarified the nomenclature and has suggested a clinical course which has yielded satisfactory results in selected cases. This study was undertaken in order to learn what is or what is not the cause of the bleeding and we think that we have succeeded in the latter. The material is comprised of 25 specimens removed surgically for various reasons,

such as bleeding, prolapse of the uterus, mistaken diagnoses of uterine fibroids, etc. In 16 cases there was vaginal bleeding of varying severity and duration, lasting from several days to 2 years at both extremes, being of menorrhagic and metrorrhagic type and sometimes uninterrupted for several weeks to 2 months. In one of the cases a preliminary curettement was performed for diagnostic purposes shortly prior to the hysterectomy, with no amelioration of symptoms. In another case the uterine cavity was cleaned and radium inserted without a noticeable effect upon the hæmorrhage. In 9 cases there was no bleeding at all. In one of them, the menstrual periods occurred every 2 weeks and were of moderate duration and amount. In another there was amenorrhœa of 3 to 4 months, followed by a normal menstrual flow. These 9 non-bleeding uteri served as controls, for we aimed to compare the histopathology of the bleeding uteri with that of the non-bleeding, although we did not consider the last group normal, because some of them were prolapsed, others considerably enlarged, and the only clinical distinction between those two groups was the presence or the absence of bleeding.

Of interest also were the findings of associated pathology in the rest of the genital tract, such as in the ovaries or tubes, or both these structures, and whenever it was possible, we gave the data about the condition of the

How shall we approach such an appraisal? The question requires serious thought and ample discussion if we are to attempt one at all or make one which will be satisfactory and convincing. Various ways at once suggest themselves but on reflection seem of doubtful value. A way which appeals to me is to judge our educational methods as we judge other methods in surgery—by the results they have achieved in this country in the past 30 years—results in the form of men distinguished in surgical practice in surgical teaching and in surgical research. It is a way which might appeal to surgeons generally who no longer are concerned chiefly with their immediate but with their late results. Such an educational survey seems at first glance stupendous but my own experience in the follow up of graduate students leads me to believe that it is not impossible. But whatever way may seem best one of its important objects should be to convince ourselves as teachers that the students' judgment of our graduate instruction is right or to convince them as students that their judgment is wrong. Such convictions are essential to harmonious progress toward better graduate teaching.

In the minds of many the difficulty with the form of graduate teaching the student seeks lies not in its desirability but in its more general applicability—in the belief that there is generally lacking the facilities for properly conducting it. My experience leads me to say that for its success it is necessary to have (1) a group of excellent teachers so imbued with the desire to instruct others that they are willing to curtail some of their own activities (2) a hospital with from 75 to 100 (preferably more) active surgical beds fully controlled in the sense that they may be used for teaching purposes (3) a surgical laboratory for pathology and experimental surgery (4) a library and (5) fellowships for those students

who may need financial aid. How many of our university medical schools can or could meet these requirements? How many of the larger hospitals throughout the country can do so? Can one not imagine the university medical schools and the larger hospitals closely linked in a great educational effort? In such a scheme the position of surgeon in chief or surgical director of a hospital would be a recognized teaching post as in a medical school the incumbent of which would be responsible for the graduate teaching. I need not elaborate the idea you can yourselves do so if you choose. In its final development it leads to the conception of our university medical school as the centers of graduate as well as undergraduate teaching each surrounded by its group of affiliated hospitals and all closely united in the common aim of educating surgeons. All this of course is visionary but if we are to educate the number of surgeons the country needs and in the way they desire we must expand our educational efforts beyond our medical schools and attempt to affiliate with them in this effort a certain number of our larger hospitals. Rightly carried out such an educational program would I think go a long way toward solving many problems. It would give graduate students greater opportunities for acquiring the education they want it would elevate the present standards of surgery and it would improve the service rendered the charity semi-private and private patient. It would by creating many additional teaching posts partly solve the problem of the second strain men—men eminently qualified to teach and practice who nevertheless remain too long in the subordinate positions of teaching clinics. Might it not also contribute toward the solution of one of the problems which most nearly confront this organization—the qualification and fitness to practice of surgeons and the ethics of the surgical profession?

closely to those described by Schroeder in cases of "myopathia hæmorrhagica," a detailed description of which will be given below

In the bleeding group of our series the most marked feature observed was the hyperplastic condition of the glands (the term 'hyperplasia endometrii' we do not use in the special sense of the word to describe a pathological entity, but in the same sense as it is employed in general histopathology)

In 10 cases, the glands were seen uneven in size, lined with cylindrical epithelium, the nuclei of which were intensely stained with basic stains. In all these 10 cases the majority of glands were dilated and not infrequently lined with many layered cylindrical epithelium. In 5 cases, or in 35 per cent, some of the glands were dilated into cysts, which lost their glandular appearance. These cysts were most frequently lined with cuboidal epithelium and occasionally their epithelium was flattened out. The lumina of those cysts contained amorphous debris and large epithelial cells. Along with these dilated glands we have observed in some of the specimens tortuous glands with stems of connective tissue, lined with cylindrical epithelium, trespassing upon the lumina and giving them a papillary appearance. In 2 cases, premenstrual changes were seen in the same specimens in which there were also features of hyperplasia of the endometrium. Frequently we observed an increase in the number of glands. These lay very close to each other, with the stroma scant between them. The hyperplastic and hypertrophic changes varied greatly in these 10 specimens. Sometimes the only deviation from the normal state was the very tall, intensely stained epithelium of the glands, the mucosa being sound otherwise. Occasionally goblet cells intermingled with the ordinary cylindrical cells and more frequently vacuoles were seen. The stroma we have found loose in texture in some specimens, dense and cellular in others. Frequently, especially in those cases in which the glands were distinctly dilated, we noticed mitotic figures in the framework of the mucosa. A peculiarity seen in some of the specimens was large mononuclear cells with a wide protoplasm, the nuclei of which were displaced to one side. Necrotic

areas we met three times in the bleeding group, most prominently in the case that received radium some time prior to the hysterectomy. In some specimens, the framework of connective tissue stroma was increased in amount and appeared thicker and coarser than usual. This fibrosis of the endometrium was particularly well exemplified in 3 cases. In the bleeding group there were 4 specimens which revealed no demonstrable deviation from normal in the endometrium, except the presence of cystically dilated glands in 2 of them. None of these 4 cases had any ovarian alterations. In the 10 cases which showed some degree of glandular or stromal hyperplasia, 9 were associated with ovarian abnormalities and 1 had no ovarian pathology whatsoever. In 1 case only we observed mononuclear cells of large size, in which the nuclei were very pyknotic and surrounded by a light halo, which gave the impression of being plasma cells. This was the only specimen in the bleeding group which gave evidences of a chronic inflammatory process in the endometrium (this case received radium treatment 6 months prior to the laparotomy).

Besides authors who believed in endometrial changes as the main feature of idiopathic uterine bleeding, there were others who, quite early in the history of this question, sought the cause of bleeding in the mesometrium and focused their attention upon every constituent of this structure. The term itself "chronic metritis" as this condition has been and is still called, implied that the etiological factor was localized in the myometrium and was of inflammatory nature (at the present 'chronic metritis' is not used in that sense).

Prior to 1902, many works upon 'chronic metritis' contained a description of the uterine wall in which the amount of fibrous tissue was increased, but the early writers did not ascribe much importance to that fact. On the contrary, Theilhaber and Meier in 1902 considered the increased amount of fibrous tissue as an etiological factor in idiopathic uterine bleeding. They thought that the decreased power of uterine contractions or as they name it 'insufficiencia uteri' was responsible for the bleeding. They contended that the uterine contractions play an important rôle in the circulation of this organ, assisting the outflow

appendages In the bleeding group we found pathological changes in the ovaries or in the tubes or in both of these organs In only 4 cases was there no associated pathology in the entire genital tract while in 2 cases there was chronic salpingitis only In 10 cases there were pathological findings in the ovaries 4 times the ovaries alone deviated from normalcy 4 cases showed abnormalities in the ovaries with accompanying chronic salpingitis in 2 cases in addition to the changes in the ovaries small intramural fibroids were found These fibroids were so small and insignificant that they escaped not only clinical detection but they were invisible during the operation their presence being discovered only upon cut section of the specimens Because in all of these cases in which chronic salpingitis and small intramural fibroids were found during the operation or in the laboratory the bleeding was considered idiopathic from the clinical standpoint we included them in our study

To summarize the condition of the adnexa in this group we may say that of 16 cases 10 or 60 per cent showed pathological changes in the ovaries while in 36 per cent of the total the tubes were involved with or without ovarian pathology The ovarian pathology was described as cystic ovaries and serous cysts (we did not observe ourselves the pathological condition of the ovaries as for obvious reasons many of them were left *in situ* by the surgeons)

The majority of the patients in the bleeding group were in the fourth decade 10 patients in the fourth decade 4 in the fifth 1 in the sixth and 1 in the seventh decade in the total of 16 patients parity varied as follows nulli para 5 ii para 3 iii para 1 vi para 1 vii para 1 ix para 1 xv para 1 unknown parity 3 Of the 16 cases there were 5 nulliparous 8 multiparous patients and the parity of 3 was not learned from the history available to us The shortest period of bleeding was 4 days the longest 2 months the majority bled 3 to 4 weeks continuously

Grossly the specimens were found to be enlarged firm and of normal shape On cut section fibrous bands could be seen by the naked eye the blood vessels were enlarged in caliber and protruded above the surface of the mesometrium This picture was not the rule

however In some cases the uteri were found small or of normal size with no blood vessels seen macroscopically The size of the uterine cavity varied from 5 to 10 centimeters The endometrium was found thin or of normal thickness in all but 2 cases in which it was polypoid and thick We endeavored to study minutely every histological structure of the entire uterus In the endometrium we paid particular attention to the condition of the glands and stroma in the mesometrium the fibrous tissue elastica and blood vessels were scrutinized In order to bring out to the best advantage the various structures we stained each specimen with hemalum and eosin according to the usual technique with van Gieson in order to differentiate fibrous from muscle tissue and with Weigert's stain for elastic tissue

In the early days in the history of irregular uterine bleeding various authors had been observing changes in the uterine mucosa which they thought were either inflammatory or hyperplastic in nature Such changes were observed by Recamier in 1830 Olshausen in 1875 described them as chronic hyperplastic endometritis or endometritis fungosa Bischoff (quoted from W Shaw) as adenoma diffusum Ruge in 1880 spoke of 3 forms of endometritis which he held responsible for irregular uterine bleeding namely 1 interstitial 2 glandular and 3 mixed

Ruge's views enjoyed wide popularity until Hirschmann and Adler in 1907 proved conclusively that the condition of the mucosa which Ruge considered inflammatory and pathologically hyperplastic was physiological for certain phases of the menstrual cycle These 2 authors put the knowledge of endometritis on a scientific basis postulating that infiltration with leucocytes and especially with plasma cells is the prerequisite of an inflammation in the endometrium as elsewhere in the body Novak Novak and Martzloff found characteristic changes in the corporeal mucosa in cases of functional uterine bleeding These changes according to these authors are so constant and typical as to form if not a clinical at least a pathological entity

W Shaw observed in 25 per cent of his series alterations in the mucosa which corresponded

of elastica were found in the mesometrium and in the media of the large arteries, also the internal and external elastic laminae were greatly thickened. In a few of the multiparous specimens, the muscle of the media almost disappeared and was replaced by elastic tissue. The largest amount of it was seen in multiparous women of advanced ages, such as 63, 55, and 49 years, but on the other hand, a woman of 32 years, ii-para, with no history of abortions had an extreme quantity of elastica. As we shall see later the same character and distribution of elastic tissue was found in the non-bleeding group, and in no way, we thought, did this structure differ in either of the groups.

Considerable attention was paid to the condition of the blood vessels in cases of "chronic metritis" by the early students of this question. Cruveilhier, Rokitsansky (quoted from Wittek) considered the fragility of the blood vessels in elderly women as a cause of hemorrhagic infarction of the uterine wall, which they called "apoplexia uteri." Cornil (quoted from Wittek), Pichevin and Petit and Marchesi described cases of uterine bleeding in which there were prominent sclerotic changes in the blood vessels. The most popular advocate of arteriosclerotic changes in the uterine blood vessels was Reinecke, whose views in 1897 achieved the importance of a theory. The author believed the changes observed by him in the blood vessels to be of arteriosclerotic character and moreover of etiological moment in the bleeding of elderly women. Both Chalmogoroff, in 1900, and Wittek, in 1906, supported Reinecke's theory. The findings and views of Reinecke were subjected to revision by subsequent authors who thought the blood vessel changes were of physiological nature for old age and multiparity (Theilhaber, Findley, Hirsch, Pankow, etc.).

In our own study we have found the blood vessels thickened from extreme to moderate in 11 cases. The most marked changes were observed in a xv-para, aged 55 years, in a multipara of 63 years, and in a ix-para, of 37 years. A moderate thickening we saw in a nulliparous woman who underwent eight abortions. The thickening involved the media and adventitia mostly, but on a few occasions we found the intima also thickened. The

thickening of the latter structure is best demonstrated by the Weigert's stain for elastic tissue. Hyalinized areas of the media were observed in the same cases in which hyalinization of the myometrium was seen. The blood vessels were gaping in some cases, narrowed in others, and occasionally their lumina were completely obliterated (all these phenomena could be observed in the same specimen).

In 8 cases, or in 50 per cent, a distinct endometriosis was observed. Within the mesometrium at a short distance away from the mucosa and not connected with it in any manner, there were found one or more glands, surrounded by endometrial stroma.

In no case were there seen inflammatory lesions in the mesometrium.

Summarizing the histological findings in the bleeding uteri, we may say that

- 1 Hypertrophic and hyperplastic changes in the endometrium of various degrees, were seen in 10 cases or in 70 per cent of the total, in which the mucous membrane was available for study. (In 2 cases the endometrium was not seen.) In 2 cases, besides signs of hyperplasia, early premenstrual changes were noticed.

- 2 Cystic glands were seen distinctly in 5 cases, or in 35 per cent. In others the cysts were hardly distinguishable from moderately dilated glands, or absent altogether.

- 3 Necrosis of the stroma was found in 3 cases or in 21 per cent and distinct signs of chronic inflammation of the mucosa were observed in 1 case only, in which radium had been inserted.

- 4 Fibrosis, excessive to moderate, was the rule. In 12 cases the amount of fibrous tissue exceeded that of the myomatous, in 4 cases they were equal. The extreme amount was observed in aged and multiparous women, with few exceptions.

- 5 The elastica was found increased in amount in parous uteri only, and this amount bears no relationship to the severity of bleeding. It seems that the amount of this structure depends not only upon age and parity, but is subjected to individual variations.

- 6 Blood vessels were found thickened in the majority of cases, namely in 11, but most prominently in aged and multiparous women.

of the venous blood toward the heart much as the muscles of the lower extremities do in the venous circulation. When there is an insufficiency of the uterine muscle venous stasis occurs as its result which in turn leads to overnutrition of the organ and to hypertrophy of the connective tissue. The authors also called attention to the fact that in old age the amount of fibrous tissue is increased physiologically. Lorenz in 1903, Palmer Findley in 1905, Hirsch in 1909 fully supported the views of Theilhaber upon myofibrosis uteri as the cause of its insufficiency. Schielele and Keller were among the first and strongest opponents of the fibrosis theory. They devised a method of quantitative determination of the amount of fibrous and muscle tissues. Using their method which although not exact is superior to the ones employed hitherto the authors came to the conclusion that the amount of fibrous tissue has no relationship to the intensity of bleeding; that parous uteri contain more fibrous tissue than nulliparous and this amount increases with parity.

Viewing our material from the standpoint of deviations in the content of fibrous tissue we observed decided increase in this structure in the majority of bleeding uteri. In all but 4 cases we thought the amount of fibrous tissue exceeded the muscle in the aforementioned 4 cases the amount of fibrous tissue equalled that of the myomatous. The fibrous structures were particularly increased around the blood vessels forming thick coarse bright red bands around the large arteries in a van Gieson's stain.

In some areas this increase was so pronounced as almost to obscure the muscle tissue. Next to the vascular layer we saw the greatest amount of fibrous tissue in the subserous layer where the fibrous bands formed a net which encircled the muscle. Where the fibrosis was pronounced we observed also fine delicate strands of fibrous tissue embracing small groups of muscle bundles or even individual cells. The most extreme increase of fibrous tissue was observed in the 3 following cases: (1) patient aged 55 years xv para (2) patient aged 63 years parity not known (3) patient aged 32 years iii para. In many cases of considerable fibrosis there was an ap-

preciable amount of it in the media of the larger arteries. We experienced great difficulty in judging the amount of fibrous tissue in a given specimen the reason for it lying in the fact that there is normally a large amount of fibrous tissue in every uterus. In an adult young woman the amount of fibrous tissue of the uterus equals one third of the mesometrium. In infants, children and senile women fibrous tissue forms two thirds of the bulk of the mesometrium (Theilhaber). If we take this into consideration we will realize the difficulty in detecting an additional amount unless it be considerable or a quantitative method be used. In some of the cases in which we thought the amount of fibrous tissue exceeded the myomatous we easily could be convinced that the reverse was the truth. We are therefore taking our findings with some reservations.

Much less trouble was had in estimating the amount of elastic tissue. It has been noticed that in parous uteri the amount and distribution of elastic tissue is so altered as to permit a diagnosis of parity with certainty. In parous uteri the internal elastic lamina loses its smoothness and evenness; it is much thicker and there is a distinct increase of elastic tissue around the middle tunica. The fine fibrils of elastica of nulliparous uteri are transformed after parturition into thick coarse strands which traverse the mesometrium in various directions. It is believed that during pregnancy all the constituents of the mesometrium undergo hypertrophy and during puerperium they undergo retrogression but not to the same degree—myomatous tissue involutes the most fibrous the next elastic tissue the least; hence pregnancy is associated with a permanent increase in elastic tissue (Szasz, Schwarz, Anspach). Some authors among whom are Szasz, Schwarz, Anspach, Goodall, W. F. Shaw and others attempted to study cases of irregular uterine bleeding with special reference to the elastic tissue.

In our series in nulliparae the elastic tissue was seen distinctly in the internal elastic lamina of the arteries and in very small amount in the mesometrium as fine delicate fibrils. In the parous uteri on the contrary clusters and bunches of thick coarse groups

in both groups but in a higher degree and frequency in the bleeding group. The most extreme quantity was seen, as we have mentioned before, in aged multiparous women in both groups, but this was not a strict rule, for an excessive amount of fibrous tissue was observed in a woman of 32 years, *iii*-para. Two nulliparæ of comparative youth, ages 33 and 35 years, respectively (both of them from the bleeding group), had an amount of fibrous tissue which we thought exceeded that of the muscle. But these nulliparæ were gravid sometime in their past. We must, therefore, point out that in the bleeding group the increase in this structure was observed in younger women who never bore full term children. In the non-bleeding group the increased amount of fibrous tissue was not so conspicuous as in the former group. The largest amount of it we observed in women of advanced ages, but in one instance a pronounced fibrosis was seen in a 19 year old nullipara, whose tubes were inflamed. From our small material we cannot conclude that age and parity are the only factors influencing the amount of fibrous tissue. The facts that ablation of the function of the ovaries by surgery or radiation checks the bleeding in a large number of cases, that some cases of prominent fibrosis do not bleed, and also that the amount of fibrosis is not proportionate to the amount and severity of bleeding, make us believe that fibrosis, although frequently met with in bleeding uteri, is not the cause of hæmorrhage but the accompanied feature of it.

In regard to the amount and distribution of elastic tissue in both groups, no essential difference between the bleeding and non-bleeding cases was observed. The parity and age had more to do with the amount of this structure than the absence or presence of bleeding. In general it was observed that the greater the parity the more elastic tissue the uterus contained, but this rule permits a few exceptions. In some instances we saw uteri of smaller parity having a greater amount of elastic tissue, than the ones of greater parity. In 2 cases, both *ii*-para, one having a history of abortions besides, the amount of elastic tissue was extreme, not less than in some of our cases of *vii*-para or *ix*-para. There are

possibly individual variations in this structure which do not depend upon age and parity.

Some comments are due the condition of the blood vessels. In the bleeding as well as in the non-bleeding group, there was a most constant change in the blood vessels of aged and multiparous women. No exceptions were seen to this rule. We have found unlike the majority of authors, but in accord with Wittek, the intima participating to some extent in the thickening of the blood vessels in a few cases only.

EXPERIMENTAL WORK

To our regret we did not have at our disposal the ovaries for study and we cannot express our views upon the significance of persistent follicle cysts and absence of fresh corpora lutea in cases of irregular uterine bleeding. But we can say that there was a remarkably frequent association of ovarian pathology of any kind (small serous cysts, follicle cysts, ovarian fibroid) with cases of uterine bleeding. This fact and also the frequency with which the cure is effected either by surgery of the ovaries or by the use of radium and X-rays is sufficient to arrest one's attention to the ovarian influences upon uterine hæmorrhages.

When the study of the cause of irregular uterine bleeding was in its infancy there was a vague knowledge of the relationship between the function of the ovaries and hyperplastic uterine mucosa accompanied by uterine hæmorrhages.

As early as 1882, Brennecke suspected the ovary. According to this author the thickened mucosa in some of the cases of uterine bleeding is in a state of hyperplasia which is due to ovarian influences. He proposed to call this form "*endometritis hyperplastica ovarialis*." Pankow, in 1909, attributed the cause of irregular uterine bleeding to a possible congestion of the ovaries or to any disturbance of their function. Poelzl, in 1912, was one of the first to point out with precision the departure from normalcy which she found in the ovaries in cases of irregular uterine bleeding. In 4 cases of atypical uterine bleeding in young women she observed a cystic degeneration of the ovaries (*kleinzystische Degeneration*) nowhere were seen fresh corpora lutea, and in

7 Endometriosis (the infringement of the mucosa in the mesometrium at a short distance from the normal borderline) was encountered in 8 cases or in 50 per cent

We shall analyze here very briefly the non bleeding group of cases and compare the findings with those of the bleeding variety. There were 9 cases in the non bleeding group their ages ranging from 19 to 55 years

Decad	Sec	P	tu	le	Par	Null	par	P
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117
118	119	120	121	122	123	124	125	126
127	128	129	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153
154	155	156	157	158	159	160	161	162
163	164	165	166	167	168	169	170	171
172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198
199	200	201	202	203	204	205	206	207
208	209	210	211	212	213	214	215	216
217	218	219	220	221	222	223	224	225
226	227	228	229	230	231	232	233	234
235	236	237	238	239	240	241	242	243
244	245	246	247	248	249	250	251	252
253	254	255	256	257	258	259	260	261
262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279
280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297
298	299	300	301	302	303	304	305	306
307	308	309	310	311	312	313	314	315
316	317	318	319	320	321	322	323	324
325	326	327	328	329	330	331	332	333
334	335	336	337	338	339	340	341	342
343	344	345	346	347	348	349	350	351
352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369
370	371	372	373	374	375	376	377	378
379	380	381	382	383	384	385	386	387
388	389	390	391	392	393	394	395	396
397	398	399	400	401	402	403	404	405
406	407	408	409	410	411	412	413	414
415	416	417	418	419	420	421	422	423
424	425	426	427	428	429	430	431	432
433	434	435	436	437	438	439	440	441
442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459
460	461	462	463	464	465	466	467	468
469	470	471	472	473	474	475	476	477
478	479	480	481	482	483	484	485	486
487	488	489	490	491	492	493	494	495
496	497	498	499	500	501	502	503	504
505	506	507	508	509	510	511	512	513
514	515	516	517	518	519	520	521	522
523	524	525	526	527	528	529	530	531
532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549
550	551	552	553	554	555	556	557	558
559	560	561	562	563	564	565	566	567
568	569	570	571	572	573	574	575	576
577	578	579	580	581	582	583	584	585
586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603
604	605	606	607	608	609	610	611	612
613	614	615	616	617	618	619	620	621
622	623	624	625	626	627	628	629	630
631	632	633	634	635	636	637	638	639
640	641	642	643	644	645	646	647	648
649	650	651	652	653	654	655	656	657
658	659	660	661	662	663	664	665	666
667	668	669	670	671	672	673	674	675
676	677	678	679	680	681	682	683	684
685	686	687	688	689	690	691	692	693
694	695	696	697	698	699	700	701	702
703	704	705	706	707	708	709	710	711
712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729
730	731	732	733	734	735	736	737	738
739	740	741	742	743	744	745	746	747
748	749	750	751	752	753	754	755	756
757	758	759	760	761	762	763	764	765
766	767	768	769	770	771	772	773	774
775	776	777	778	779	780	781	782	783
784	785	786	787	788	789	790	791	792
793	794	795	796	797	798	799	800	801
802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819
820	821	822	823	824	825	826	827	828
829	830	831	832	833	834	835	836	837
838	839	840	841	842	843	844	845	846
847	848	849	850	851	852	853	854	855
856	857	858	859	860	861	862	863	864
865	866	867	868	869	870	871	872	873
874	875	876	877	878	879	880	881	882
883	884	885	886	887	888	889	890	891
892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909
910	911	912	913	914	915	916	917	918
919	920	921	922	923	924	925	926	927
928	929	930	931	932	933	934	935	936
937	938	939	940	941	942	943	944	945
946	947	948	949	950	951	952	953	954
955	956	957	958	959	960	961	962	963
964	965	966	967	968	969	970	971	972
973	974	975	976	977	978	979	980	981
982	983	984	985	986	987	988	989	990
991	992	993	994	995	996	997	998	999
1000	1001	1002	1003	1004	1005	1006	1007	1008
1009	1010	1011	1012	1013	1014	1015	1016	1017
1018	1019	1020	1021	1022	1023	1024	1025	1026
1027	1028	1029	1030	1031	1032	1033	1034	1035
1036	1037	1038	1039	1040	1041	1042	1043	1044
1045	1046	1047	1048	1049	1050	1051	1052	1053
1054	1055	1056	1057	1058	1059	1060	1061	1062
1063	1064	1065	1066	1067	1068	1069	1070	1071
1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089
1090	1091	1092	1093	1094	1095	1096	1097	1098
1099	1100	1101	1102	1103	1104	1105	1106	1107
1108	1109	1110	1111	1112	1113	1114	1115	1116
1117	1118	1119	1120	1121	1122	1123	1124	1125
1126	1127	1128	1129	1130	1131	1132	1133	1134
1135	1136	1137	1138	1139	1140	1141	1142	1143
1144	1145	1146	1147	1148	1149	1150	1151	1152
1153	1154	1155	1156	1157	1158	1159	1160	1161
1162	1163	1164	1165	1166	1167	1168	1169	1170
1171	1172	1173	1174	1175	1176	1177	1178	1179
1180	1181	1182	1183	1184	1185	1186	1187	1188
1189	1190	1191	1192	1193	1194	1195	1196	1197
1198	1199	1200	1201	1202	1203	1204	1205	1206
1207	1208	1209	1210	1211	1212	1213	1214	1215
1216	1217	1218	1219	1220	1221	1222	1223	1224
1225	1226	1227	1228	1229	1230	1231	1232	1233
1234	1235	1236	1237	1238	1239	1240	1241	1242
1243	1244	1245	1246	1247	1248	1249	1250	1251
1252	1253	1254	1255	1256	1257	1258	1259	1260
1261	1262	1263	1264	1265	1266	1267	1268	1269
1270	1271	1272	1273	1274	1275	1276	1277	1278
1279	1280	1281	1282	1283	1284	1285	1286	1287
1288	1289	1290	1291	1292	1293	1294	1295	1296
1297	1298	1299	1300	1301	1302	1303	1304	1305
1306	1307	1308	1309	1310	1311	1312	1313	1314
1315	1316	1317	1318	1319	1320	1321	1322	1323
1324	1325	1326	1327	1328	1329	1330	1331	1332
1333	1334	1335	1336	1337	1338	1339	1340	1341
1342	1343	1344	1345	1346	1347	1348	1349	1350
1351	1352	1353	1354	1355	1356	1357	1358	1359
1360	1361	1362	1363	1364	1365	1366	1367	1368
1369	1370	1371	1372	1373	1374	1375	1376	1377



Fig 1 Specimen 641 Patient was a 1 para of unknown age The endometrium appears to be moderately hypertrophic and hyperplastic A distinct endometrosis is observed at a short distance from the mucosa Hematoxylin eosin stain



Fig 2 Specimen 5656 From a multipara (the exact parity not known) of 55 years This specimen reveals large cystic glands in the endometrium, the rest of which does not show signs of hyperplasia The glands of the mucosa are rather narrow, epithelium of normal appearance, the stroma varies in density, the cysts are lined with low cuboidal and flattened epithelium, their cavities contain amorphous debris Hematoxylin eosin stain



Fig 3 Specimen 5734 In this instance parity was not known The patient was 55 years old In this section the thickened blood vessels are seen very distinctly In one of the arteries there are calcified areas seen as dark blue spots A large vein is shown extremely thickened with the lumen reduced to a slit Hematoxylin eosin stain



Fig 4 Specimen 5604, from the bleeding group The parity is not known, patient's age was 63 years This specimen demonstrates distinctly the participation of the intima in the thickening of the blood vessels There is a large amount of elastic tissue within the mesometrium which appears as intensely dark stained, coarse bands and clusters The internal elastic lamina is thickened and uneven Weigert stain for elastic tissue

3 of these 4 cases the endometrium was thickened and hyperplastic. She believed that there is a causative relationship between the ovarian changes and the uterine bleeding. Schroeder in 1913 and 1919 gave the most impressive evidences in favor of the ovarian theory of uterine bleeding. The author believes that the cause of that variety of uterine bleeding which has no discernible clinical signs and which he calls metropathia hemorrhagica lies in the ovaries. In all his series the mucosa was found in a state of pathological proliferation. In all cases in which the adnexa were available for study the ovaries showed persistent follicle cysts and absence of fresh corpora lutea formation. Schroeder considers that the follicle fluid exerts an influence upon the endometrium and causes its hyperplastic condition. Novak, Novak and Martzloff, Babes, Wilfred Shaw, and others supported in main the ovarian theory of functional uterine bleeding. However not all observers have invariably found persistent follicle cysts and lack of fresh corpora lutea in the ovaries.

From our material we are not in a position to say with precision in what condition the graafian follicles and the corpora lutea were found as we ourselves did not study the ovaries microscopically. We wish to point out that although very frequently pathological changes in the ovaries were found in cases of uterine bleeding nevertheless not infrequently the same type of pathology was seen in the non bleeding group. If it is true that in our series 60 per cent in the bleeding group showed ovarian abnormalities it is also true that in the non bleeding group 42 per cent of inspected adnexa revealed alterations in the ovaries. If the future should disclose the ovaries as the main cause of uterine bleeding that discovery might be due to the new methods of biochemical investigations. We doubt whether the histopathology of the ovary alone would clarify the question to a greater extent than the histology of the uterus did but we are inclined to believe that experimental studies of the gonads may throw some light upon this obscure cause of uterine bleeding.

Having in mind the idea that the ovarian malfunction and hyperfunction could be re-

sponsible for uterine bleeding we attempted to inject into animals the female sex hormone in order to detect any possible alterations in the uterine structure. We did not discriminate between the source of origin of the ovarian hormone for we were under the impression that various kinds of oester producing female sex hormone act similarly upon the uterine mucosa and sexual life of the animal (Frank). What we actually wanted was to see whether prolonged hyperaemia incidental to hyperfunction of the uterus would produce fibrosis and whether prolonged action of the female sex hormone is capable of creating an histological picture similar to hyperplasia endometrii (pathological entity). For our experiments we chose dogs, rabbits and guinea pigs. The dog and the rabbit proved animals too big for the amount of material used therefore in our later work we confined ourselves to experiments on guinea pigs only. Young virgin guinea pigs were injected with oester producing hormone, amniotin (Squibb). One half cubic centimeter which contained 10 Allen Doisy units was injected subcutaneously every other day until 15 doses were given. The injection we began on the fourth day after a laparotomy removing the right horns of 2 animals. A month later we removed the left horns of the same animals and after sectioning and staining compared the histological picture with the right horns. Only mild changes were observed in the uterine mucosa and none whatsoever in the endometrium. We did not see any alterations in the stroma of the endometrium but some of the glands in the injected animals showed signs of activity. The epithelium of the glands became more transparent and taller and irregularly arranged at some areas. The lumina of these glands were filled with a mucoid substance. We tested the potency of amniotin by the Allen Doisy vaginal smear test and we found it mildly active that is to say that the vaginal smear revealed a preponderance of epithelial cells but these were mostly nucleated. In view of the fact that commercial products are not suitable for experimental work and also that we were not in a position at that time to produce the hormone in our laboratories we discontinued the experiments.

TOXIC NEURONITIS OF PREGNANCY

A CLINICOPATHOLOGICAL REPORT

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THAT infections, trauma, and pressure upon nerves during pregnancy may produce paralysis is well known, but it is not well recognized that paralysis may result from some form of autointoxication during pregnancy. Textbooks on neurology and obstetrics discuss briefly, if they mention at all, the existence of such a complication. Even the most recent monographs and critical reviews dealing with toxæmias of pregnancy fail to include polyneuritis or neuronitis with other complications, such as eclampsia, chorea of pregnancy, and pernicious vomiting. It is true that paralysis from toxæmia of pregnancy is seldom encountered, but the existence of such a paralysis has long passed beyond the stage of doubt. It is likely that its presence will be less frequently overlooked when the attention of the profession has been sufficiently directed toward it.

The nerve involvement with which this paper will deal occurs usually in the early part of pregnancy and usually follows uncontrollable vomiting. Cases of paralysis occurring after delivery will not be included in this report. With our present knowledge, it is difficult to be sure that toxic changes appearing in the nervous system after delivery are of the same or similar origin as those appearing during pregnancy. The occurrence of infection and local injuries to the sacral plexus is so common that it is difficult to rule out these possibilities in many instances. In most cases of postpartum paralysis elevation of temperature and absence of hyperemesis have been reported. In consideration of these facts, cases of paralysis occurring after delivery will not be included in this report.

Up to the latter part of the nineteenth century, cases of paralysis associated with pregnancy have appeared sporadically in the literature by Gamet, Abeille, Colombet, and others, but insufficient data accompanying them and indefinite clinical and laboratory

findings prevented the condition from being recognized as a definite entity. Jolly published in 1885 reports of 2 cases which may be regarded as a presentation of paralysis due to a toxic condition arising during pregnancy, although he believed the paralysis to be of a functional origin. Four years later a committee of the French Academy of Medicine (12) reported on a case presented by Desnos, Joffroy, and Pinard. The committee thought the paralysis was due to a reflex action from the uterus. The same year, Whitfield reported the first case in the English literature. Since then cases have appeared more frequently. In 1904-1905, Hoesslin published an extensive monograph describing 493 cases of paralysis associated with pregnancy. In this paper he included all types of paralysis, independent of and dependent upon pregnancy, and regarded 46 of them directly due to autointoxication either before or after delivery.

Although a rather large number have been reported in the literature as toxic nerve changes of pregnancy, critical examination of the records revealed obvious errors in diagnosis in some, and in others the data were insufficient to exclude the possibility of neurological changes having developed from exogenous infections or other sources. After eliminating all of such questionable cases we were able to collect 52 in which we believe the neurological changes were dependent upon pregnancy. We, ourselves, have had the opportunity of observing 4 more cases. Three of these died and a postmortem examination was made on each. The fourth patient recovered.

REPORT OF CASES

CASE 1. M. S., married, aged 29 years, was brought to the University Hospital on a stretcher on October 2, 1926. Her family history was negative. She was a college graduate and had taught school up to the onset of her present illness. She had had two attacks of hysterical aphonia precipitated

on animals and limited our interest to the clinical material. We do not know whether another more potent product would cause any alterations in the mesometrium and endometrium. But we do know that amniotin in the dosage used was not sufficiently efficacious to produce the expectant pathological picture except mild degrees of pro-oestral changes. Before we can draw conclusions as to the ability of the oester producing female sex hormone to cause changes other than pro-oestral more potent products should be used in a larger number of animals.

SUMMARY AND CONCLUSIONS

1 Hyperplastic and hypertrophic conditions of the endometrium were seen in the bleeding group as well as in the non bleeding but with more frequency in the first one.

2 Cystic glands of the mucosa were observed in hyperplastic endometrium frequently but not as a rule. Occasionally a normal mucosa showed the same cystic transformations. Cystic endometrium was met with in the non bleeding as well as in the bleeding group of cases.

3 Fibrosis uteri was observed in both groups but more often and to a higher degree in the bleeding variety.

4 No essential difference in the condition of the blood vessels has been noted in these two groups these changes fibrotic in character occurred most frequently in aged and parous women (the dependence from these condition is not absolute).

5 No difference in the amount and distribution of elastic tissue was seen in the uteri of these groups the variation depended upon parity largely and to some extent they were individual in character.

6 On no occasion was an inflammation of the myometrium seen.

7 A departure from a normal condition of the ovaries was seen in the bleeding cases more frequently than in the non bleeding group. In about the same proportion mild chronic salpingitis could be detected in specimens of both groups.

8 There is no single feature or a combination of features which is pathognomonic of idiopathic uterine bleeding.

I h t t h k D I P l t f h u o p t and
E e s s tan in d t g t h k

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the chest showed paralysis of the diaphragm and atelectasis of the lower lobe of the right lung

On October 10, 1926, it was noticed that pulse was growing weaker and more rapid, rising to 140 at times. The paralysis was growing more severe and a vaginal hysterotomy was recommended. The operation was performed under caudal anaesthesia. A macerated fetus about $3\frac{1}{2}$ to 4 months old was delivered. During the completion of the operation the patient went into shock, her pupils dilated, and her pulse and respiration gradually failed. She died on the operating table.

Diagnosis (1) Toxic peripheral neuritis and myelitis of pregnancy, (2) therapeutic abortion.

Autopsy was done 1 hour after death. In the pelvis was found 250 cubic centimeters of blood, the obvious source of which was a recently sutured operative incision in the anterior wall of the cervix and anterior peritoneal cul-de-sac. The liver and kidneys showed a moderate degree of cloudy swelling, but their weights were well within normal limits. None of the other organs were abnormal in even the slightest degree. Gross pathological changes were entirely lacking in the brain, spinal cord, and peripheral nerves.

Histological study. About the centers of the lobules of the liver was a minimal amount of fatty metamorphosis. The cells of the convoluted tubules of the kidneys showed moderate swelling and granular degeneration of their cytoplasm. All other organs of the abdominal and thoracic cavities were normal. The thyroid gland was normal.

In the lumbar portion of the spinal cord there was advanced chromatolysis of the anterior horn cells (Fig. 1). In the larger number of these cells distinct Nissl bodies were entirely lacking, and the cytoplasm was stained a dirty blue. Many of the cells were greatly swollen and almost spherical in shape. Nuclei were frequently eccentric, and occasionally even protruded, in part beyond the margins of the cell body. The characteristic staining reactions of some cells were lost. The irregularity in outline and structure of these cells made it obvious they were in the early stages of necrosis. In both the gray and white matter of this portion of the cord were a number of tiny fresh petechial hemorrhages. No inflammatory lesions were found, however, either in the cord or its meninges at this level. The glial tissue and blood vessels seemed entirely normal and there was no evidence of tract degeneration. In one section taken from the thoracic portion, a small inflammatory lesion was found in the pia arachnoid. This consisted of mild proliferative changes in the fixed connective tissues, and infiltration by a few lymphocytes and mononuclear wandering cells. There were no changes in the nerve cells at this level, and no hemorrhages were found. The cervical portion was without histological changes. Careful search of the brain failed to reveal pathological changes by any method of study. Marchi preparations of the left femoral nerve and the phrenic nerves revealed outspoken degeneration of large numbers of fibers (Fig.



Fig. 2 Case 1. Left femoral nerve, proximal portion. Marchi stain. Photomicrograph showing degeneration in a large number of nerve fibers.

2) Fat droplets were numerous and large, and in many portions the neurilemmae of the affected fibers were collapsed and empty. There were no proliferative or exudative changes in any of the nerves examined.

CASE 2. N. W., married, aged 28 years, entered the University Hospital September 16, 1929. Her family history was essentially negative. She completed the sixth grade in common school and then left school to help work on her parents' farm. She was considered to be emotionally unstable, easily excited and worried about trifling matters. She married at the age of 20 years. One year later she became pregnant. She had severe vomiting beginning about the sixth week and entered a hospital 2 weeks later. She was not given anything by mouth but was given nourishment by rectum. Twelve days later the vomiting was controlled and she returned home. She complained of some pains in her legs but she was not examined neurologically. She then continued through her pregnancy and delivered a normal child at term.

She became pregnant for the second time about April 15, 1929, and began to vomit about May 10, 1929. Her vomiting became so severe that she was forced to enter a hospital at her home town the latter part of that month. The vomitus was blood tinged at times. She remained at the hospital for about 1 week and then returned home. Again she began to vomit and was sent back to the hospital, where she was treated about 10 days. She improved and returned home, but her vomiting again became severe. Two weeks later she returned to the hospital for the fourth time, where she remained for a period of 5 days. She was then discharged but she was obliged to return to the hospital for the fifth time 2 weeks later. At this time she was pregnant about 3 months. She began to complain of numbness in the lower extremities and she continued to vomit. The physician noticed weakness and tenderness in the lower limbs.



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those in the lumbar segment, but somewhat less marked. In the entire cord no evidences of nerve tract degeneration could be demonstrated, and the spinal meninges were normal. In the medulla oblongata, early chromatolytic changes were found in the hypoglossal nuclei. In the left lenticular nucleus was a solitary, small vessel surrounded by a collar of lymphocytes. In the region of the right superior frontal gyrus were found mild proliferative changes about a number of subcortical vessels (Fig 4). About the same vessels were infiltrations of phagocytic mononuclear cells containing granules of blood pigment. Careful search of all other portions of the brain failed to reveal other pathological changes. Evidences of degeneration in peripheral nerves were minimal, and even questionable in Marchi preparations. By the Bielschowsky method, fragmentation and granular degeneration of neurones were demonstrated in the phrenic nerves.

CASE 3. E. S. married, aged 30 years, was brought to the Minneapolis General Hospital December 30, 1929, in a moribund condition. She was extremely toxic and weak. The patient had always been of a very nervous temperament. She had had frequent temper tantrums in her childhood. She did not get along with her parents and left her home when she was about 15 years old. She had one sister and an aunt in a State Hospital for the Insane. She married in 1921. She had two daughters, aged 7 and 3, and one son aged 5. Four years ago she became pregnant for the fourth time, but she had a spontaneous abortion in the fifth month. About 2½ years later she again became pregnant but after taking some chemical abortifacients she aborted in the fourth month.

Her sixth and last pregnancy began in August, 1929. About the seventh week she began to vomit, she went to a physician who was unable to control the vomiting. She tried to produce abortion by using both chemical and mechanical means on several occasions, but she was able to produce only a slight hemorrhage. She was forced to remain in bed the first week in November because of weakness. She called another physician who stopped all food by mouth and fed her by rectum. Her pulse was about 130 beats per minute and her temperature was 99 degrees. Her urine was normal. The vomiting persisted until December 15, 1929. At the time the vomiting ceased, the patient became confused and complained of severe pains in her legs and she developed incontinence of the sphincters. She was admitted to the General Hospital December 30.

Physical examination. The patient was dehydrated, delirious, restless, and unco-operative. The right eye was blind. There was a coloboma of the iris and an absence of the lens in that eye. The respirations were rapid and labored. The temperature was 102 degrees. The diaphragm was paralyzed and the patient used the accessory muscles of respiration. The blood pressure was 142-94. The fundus of the uterus was about two finger breadths below the umbilicus.

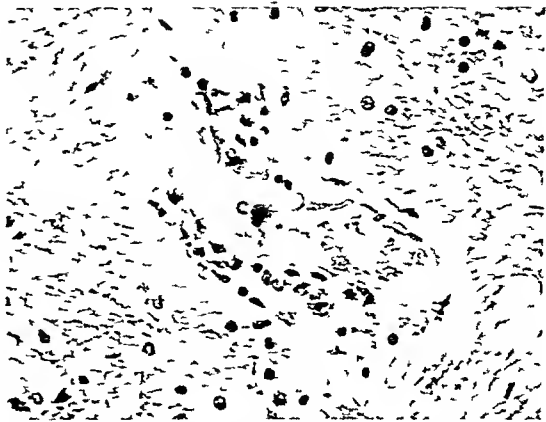


Fig 4. Case 2. A small blood vessel in the right superior frontal gyrus. Hematoxylin-eosin stain. Photomicrograph showing a number of mononuclear phagocytic cells containing granules of blood pigment about a small blood vessel.

Neurological examination. The ophthalmoscopic examination of the right eye showed an old optic atrophy due to the congenital defect of that eye. The left eye showed optic neuritis with small fresh hemorrhages in the retina. The left eye reacted to light and accommodation. The rest of the cranial nerves were negative. The biceps and triceps reflexes were normal. The abdominal, patellar, hamstring, and ankle reflexes were absent. The diaphragm was paralyzed. There was marked weakness of the extremities, especially in the lower limbs. Muscle and tendon pain sense was increased.

Mental. The patient was disoriented and delirious. She was unable to answer questions or to cooperate in the examination.

Laboratory data. The specific gravity of the urine was 1027. There was a faint trace of albumin and no sugar. There were four pus cells per high power field in the centrifuged specimen, but no other formed elements. The hemoglobin was 65 per cent. Erythrocyte count 3,500,000, leucocyte count 8,100, with 80 per cent polymorphonuclears. The spinal fluid was clear, the globulin test was negative, and the pressure was normal. There were no cells. The Nonne and Wassermann tests were negative. The blood urea nitrogen was 7.2 milligrams per 100 cubic centimeters and the blood sugar was 680 milligrams per 100 cubic centimeters (after intravenous glucose). The carbon dioxide combining power of the plasma was 53 per cent.

The patient did not respond to vigorous forcing of fluids and intravenous glucose. Her pulse and temperature continued to rise and she died on the third day in the hospital.

Diagnosis. (1) Toxic neuronitis of pregnancy, (2) bronchial pneumonia.

Autopsy was performed 1 hour after death. The positive gross findings at autopsy were mild edema



FIG. 3. Case A. t h m ll th l mb p
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A few days later the patient had a relapse of her
legs. For a short time she was able to walk, but
then she became unable to do so. She was
admitted to the hospital on September 18th. She
was found to have a large tumor in the right
leg. The tumor was found to be a sarcoma. She
was operated on on September 25th. The tumor
was removed. She was discharged on October 1st.
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was found to have a large tumor in the right
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nitrogen was 14.47 milligrams per 100 cubic centimeters and the blood sugar was 80 milligrams per 100 cubic centimeters. The blood Wassermann test was negative. Nose and throat cultures were negative. X-ray examination of the chest showed massive atelectasis of the right lung. The carbon dioxide combining power of the plasma was 48 per cent.

A few days after the operation the vomiting ceased. The neurological symptoms, however, continued to progress for two weeks. The legs and arms became weaker, and the patient complained of pains in her extremities. About March 1, she began to improve. She became oriented but she had almost a complete amnesia for the events of the previous 2 weeks. She stated that her extremities became numb immediately after the operation but she could not recall what happened for 2 weeks after the operation. The patient was discharged from the hospital in April, 1930. On July 27, 1930, she wrote that she was putting on weight and walked a few steps. Nine months later she returned to the University Hospital and was found to be negative except for some atrophy and slight amount of contractures in her lower extremities. She was able to walk for long distances and had no complaints.

ETIOLOGY

Many divergent suggestions have been offered to explain the etiology of neuronitis of pregnancy. In 1859, Churchill offered anæmia, uræmia, rheumatism, and hysteria as possible causes of the paralysis. Jaccoud (1886) made a highly theoretical suggestion that the paralysis was due to exhaustion of the nervous system by prolonged and continual excitement of the cord, and that the impulses were transmitted by the uterine nerves, exhausting the excitability of that particular segment of the cord and closing the avenues by which motor impulses pass. A little later Jolly ascribed the paralysis to hysteria. Moebius (1887) was one of the first to suggest a theory of autointoxication, a concept which is generally accepted at the present time. He believed that some "morbid condition of the blood" of the pregnant woman was the causative factor. Tuilliant, noticing that severe vomiting preceded the neuritis, suggested that the lack of nourishment was the probable cause. To refute this theory, Lindemann undertook a series of observations on dogs, and his results showed that malnutrition alone, however extreme, failed to show any microscopic degenerative changes in nerves. Polyneuritis resulting from starvation has been

reported by Schlesinger and others, but histopathological studies have been largely neglected. Inasmuch as the majority of the cases of toxic neuronitis of pregnancy cleared up following the interruption of pregnancy, it appears that the neuritis is not due to inanition. Hassin studied the brain of a man who starved to death. He found no structural changes in the nerve cells or nerve fibers.

Even now the etiology of toxæmia is obscure, as Stander has indicated in a recent monograph "The Toxæmias of Pregnancy." Since 50 per cent of pregnant women have nausea and vomiting in the early part of pregnancy, Bouchard made a statement that all pregnant women suffer to a greater or less extent from autointoxication. Viet held that all disturbances of pregnancy result from cytolytic processes following the entrance of fetal ectoderm into the maternal circulation. Stone, Ewing, and others maintain that vomiting of pregnancy, yellow atrophy of the liver, and eclampsia are all manifestations of disturbed metabolism and should be grouped together under a common heading of toxæmia of pregnancy. But in the cases we have studied, neuronitis of pregnancy presents a distinct picture, both clinically and pathologically, from the other complications which result from toxic conditions in pregnancy.

CLINICAL PICTURE

The clinical and pathological picture of the nerve changes in pregnancy is the same as that resulting from alcoholism, infectious conditions, and diet deficiency disturbances such as beri beri and pellagra. The diagnosis is made only by careful history and laboratory examination. The exact nature of the toxins producing neuronitis is still unknown. The blood chemistry in this condition is normal but it is realized that laboratory tests for the retention of toxic products are very crude measures of subtle metabolic processes. Cloudy swelling found at necropsy is a finer index of the retention of toxic products than any known laboratory test.

Occurrence. Age has no great significance as is seen in Table II. The condition occurs most frequently between 21 and 35 years, the period when the incidence of pregnancy is the

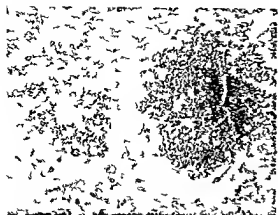


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t Len pl e e we a s o t e d th f m m
t r y ch g e s d m n t b l cul f ease I
the h t m g t of th l f t r e t l g r u
a mall c llect n of lymphocyt s f d b t

nev s l Th g n t pyram d l c lls of the ten
ent l g y s h w d th ch g s l a l y chr m
t l y s a u m b e f s m l l n s e e l und the
menige O v r th right a t r e t l g r u s a
mall a e a of th p a a h a d v a th c k e d d
t a n d a u m b e of mon n u l p h g c y t and
c a l p l m a e l l O e r the m d l f t l
g y r s m l a b u t l e s m a k e d h g e s r f n d
l n th m n g s e h g t h g h t s p e t a l
g y s t h e a a d f e e f i t a t n f m l
p h g s t e m s t f h i c h r o t a n d b l o o d p g m t
N p e g h r l r e l e s u d d b d m t r a t d
m l e m a t y n a n d e n o M r h p j r a t
B l c h o k y p p a t s e l e d l g e n t e
c h a g e i o c a n l n u a s f t h e a l p l

CASE 4 I P m a r i d g e d 4 y e a t d
the U r r y l l o p a t i j u r y 7 030 H p a t
h u r r e e t i l y n g t e S h s i n h d t h
g d c h o o l a d k e d n a t h i c t l s
y e a s S h e m a r i e d n 19 8 a d b e m p e g a t
f r t h f r t t m O t b r s 99 S h e b g n t
h e n u a d y m t g a b u t a c l s l e t
V o m t g b e a m s o s e v e r t h t h p a l a z a n
n e c s s a S h e m p e d f r o l n d r t d
h m e S h e g m e d f e q e t l y a d a d
r u t t e d t h U a e t y l l s p l l a u a r y 7 03
E c l u n f i s t e r l g d s f s o d m b m d
t a e n o u g l u e a d b t e i m f o o d b y
m t h l d t c t l t h e m t g O t b r u r
s 030 h t l k d r r t l l y n d c m p l a e d f
p n h e r i g T h e d a y a l a n a b t
a d s d b c a u e t h p t n s o d t o s g r o g
t e a l S h e m p l n e d o f d p l p a d b e
r y r s i l e s n d c o f d O F e b r a r y 4 103
t h u t e u a p a l d T h f l l o g d y h c d
t i n g e u o s t a l t h a t i m m d a t t r v t
c e s s a v a d t h e f t s m d j e c m l

P l y c o t s t t The t t t h d
d e c e s f m r k d e c n t g h i l l b r u r y
93 h p u l s e a p e m t e Th b l o o d
s e 16 86 Th e d l l s p e c u s
e g h t b e t E x p t f t c h y c a d a t h e t
n o m a l Th b d m e a f l e d
y l g a d t t The p h t l m s c f
m t o n s h e d l a g e h a m r h g s t h t
1 x Th o p t e d s c e e d d d n d t h m g n
e r b l d T h p a t n t o m p l a d f d j l
b t t h e t c i a m m t m l t h
t f t h l r m a l A l l f t h
d e p l l e b s e n t Th r m a d l g e
a k n d t h y h d d i t t t y n d t o r h
F h a k e m t m a k d n t h e d i t l m u s c l e
g p Th d a p h g m a l l d Th s e n s o
e m t d u l l i t o a l a t f t h p a t t
s e t e d u e p e t S h e d i n
t h l t t m l a t n Th p p e a r d i b e m r k d
d t h m c l s d t d n a p a s e t h
l o r t m t s
L b t y d a t Th t n d d t
d a d t n e b t a g t t h e t h
b l o o d h o d 47 p r a t h m g l b t h 3 00
l c t p e b e m o l l m t r Th b l o o d

TABLE I.—SUMMARY OF CASES—Continued

Author Year	Age Gravida	Hyper- cæmia	Motor symptoms			Sensory symptoms	Spinal cord distur- bance	Mental symptoms	Additional data	Subsequent history	Termination
			Onset	Type	Distribution						
Cuthbert and Fraser 1904	30 II	1st mo +++	1st mo	L m n	Lower ex- tremities	Moderate	Impaired sensation in extremities increased muscle tenderness	Irritable and restless but not confused	Severe vomiting in previous two pregnancies and weakness in se- cond pregnancy Pulse 120 to 170	Spontaneous abortion at 4½ months	Improved after abortion but never able to walk again
Oettinger 1901	27 II		2nd mo	U m n I m n	Hands feet, and left side of face	Moderate	Impaired sensation in extremities increased muscle tenderness			Spontaneous abortion at 7th month. Fetus was dead and emac- iated	Recovered after abortion
Brauer 1901	— XXI		5th mo	U m n L m n	Vocal cords diaphragm and ex- tremities	Marked	Paralysis and hyperæsthesia in extremities	Nervous and ir- ritable in all pre- vious pregnancies		Normal delivery	Improved
Hoeslin 1905	29 V		9th mo	L m n	Lower ex- tremities	Marked	Sensory changes in abdomen and lower limbs		Pulse 88	Normal delivery	Recovered
Alexandroff 1907	— I	1st mo +++	3rd mo	I m n U m n	1½ mus- cles up- per and lower limbs	Marked	Decreased sensation in extremities and increased muscle tenderness	Loss of mem- ory and in- creased serum de- lirium (Korsakoff's psychosis)	Optic neuritis in both eyes. Patient type of nervous type previously Pulse 135	Artificial abortion about the 5th month	Improved after abortion. Some permanent mental changes
Grund 1908	24 III		7th mo	U m n I m n	Upper and lower limbs and left side of face	Marked	Mild sensory changes in ex- tremities			Spontaneous delivery at 8th month but con- tinued to grow worse for 1 week	Much improved one year later
Huber 1908	—	1st mo +++	1st mo	I m n	Lower limbs and right arm	Marked	Loss of sensation in lower extrem- ities	'Korsakoff's psychosis'		Artificial abortion at 5th month	Improved
Irishholz 1909	31 II	1st mo +++	1st mo	U m n I m n	Lower limbs	Moderate	Spontaneous pains in legs	Definite man- ifestations	Rapid pulse	Normal delivery	Improved
Allmann 1909	21 II		5th mo	L m n	Lower limbs	Marked	Marked sensory im- pairment below level of chest	Confused and delirious		Artificial abortion at 5th month	Dead 6th month Autopsy per- formed
Dustin 1909	31 II	nd mo +++	6th mo	I m n	Lower limbs	Marked	Increased muscle pain in lower ex- tremities		Pulse 100	Spontaneous abortion at 6th month	Dead 1 week after abortion. Autopsy performed
Wallich 1910	21 I	1st mo +++	3rd mo	I m n	Lower limbs	Moderate	Impaired vision and sensation in lower extremities	Definite mental changes	Pulse 120	Artificial abortion at 1st month	Improved after abortion
Hirschschmidt, Jepic, and Dinour 1910	—	1st mo +++	1st mo	L m n	Lower limbs	Moderate	Pain in lower ex- tremities	Delirious and amnesia	Pulse 130	Artificial abortion at 1st month	Improved after abortion

TABLE I--SUMMARY OF CASES

A. Age Year	G. dx	H. per mm	M. to in. tons			Se. sory m. na	S. i er d. ub-	M. tal m. nu	Add. nat. data	Subseq. t. h. ry	T. man
			O. se	T. pe	D. b. two	Degree					
Jol 385		+++ mo	h m	L. m. a	Lo lumb	M. k. d		H. terna		Sp. lano boo two m. tha	W. k. d. m. h. ca 6 m. this after
J. l 385		+++ m	b m	L. m. a	Lo lumb	M. k. d		H. t		Ar. d. tal. h. t. th. m. th	Im. d
Des 385	J	+++ m	st. m	L. m	M. k. d. m. igh. enu. es	M. d		M. m. ry. en. p. d. d. es. dull. d	M. p. p. p. d. f. p. a. l.	Ar. ad. b. two th. m. th	Imp. d. m. th d. er. b
W. A. 385		+++ th. mo	th. m	L. m	U. p. e. lo. m.	M. d. e.				N. m. a. l. d. i. ry	Rapid. m. p. o. ven. d. l. l. ry
F. l. 385		+++ m	h m	L. m	U. p. e. an. lo. m.	M. k. d	+	A. m. a		N. bo. f. m. d. p. a. l. b. m. h	D. i. A. p. o. y. p. o. d.
L. a. 385	J. l. v.	+++ b m	b m	L. m	L. l. a. s. o. d. th. a. s.	M. k. d	+			N. b. f. m. d.	D. d. 38 m. b. A. p. a. p. o. d.
S. o. l. 385		+++ m	d m	L. m	Lo lumb	M. d		C. i. d. se. so. m. a. s. d. d. l. e. u. m.	P. l. o. g. f. m. l. a. l. d. i. s. e. a. s. e. m. h. l. a. r. n. o. l. y.	N. bo. p. e. f. m. d.	D. d. 38 m. th. A. l. o. p. o. y. p. o. d.
S. i. m. b. o. 385	I	+++ d. mo	d mo	L. m. a	Lo lumb	M. d			P. u. l. s. e. m. a. l.	D. i. ed. m. a. l. th. m. th	Im. ed. a. l. e. r.
E. l. b. e. 385		+++ th. m	b m	U. m. L. m	D. h. e. g. a. s. t. l. l. l. u. m.	M. d. e.		M. d. h. l. f. d.		Ar. 5. l. a. l. b. 5 m. b.	M. h. m. p. d. m. l. a. t. e.
M. l. e. r. 385	J	+++ d. m	d m	L. m. a	Lo lumb	M. k. d	+			A. 5. l. a. l. b. o. r. t. i. o. n. a. l. d. i. s. e. a. s. e. m. h. l. a. r. n. o. l. y.	D. d. 38 m. th. N. l. o. p. o. y. p. o. d.
E. l. d. 385	J. l. x.	+++ 6th m	6th m	L. m. a	U. p. e. a. s. t. l. l. l. u. m.	M. d				N. o. r. m. a. l. d. e. r. y.	R. e. c. o. v. e. r. e. d. u. s. e. a. s. e.
E. l. i. e. r. 385	J. l. x.	+++ th. mo	th. mo	L. m	U. p. e. a. s. t. l. l. l. u. m.	M. d				N. m. l. u. r. y.	e. c. o. r. e. d. m. o. u. t. h. a.
R. y. l. a. 385	J. l. x.	+++ m	m	L. m	U. p. e. a. s. t. l. l. l. u. m.	M. d	+			N. m. l. u. r. y.	3. p. e. o. r. e. d. m. o. u. t. h. a.
B. o. u. a. r. d. 385	J. l. x.	+++ m	m	L. m	U. p. e. a. s. t. l. l. l. u. m.	M. d	+			N. m. l. u. r. y.	N. l. e. t. b. o. r. t. i. o. n. a. l. u. s. e.

TABLE I—SUMMARY OF CASES—Continued

Author Year	Age Gravida	Hyper- emesis	Onset	Type	Motor symptoms	Degree	Sensory symptoms	Spasmodic disturbance	Mental symptoms	Additional data	Subsequent history	Termination
Lj 1922	26 1	2d mo ++ + + +	14th mo	I m n	Dysphagia lower limbs	Moderate	Decreased sensation in lower limbs	+	Confused disoriented and emotional	Pulse 120	Artificial abortion at 4th month. 1 analysis 2 weeks later	Improved
Lj 1922	— 1	nd mo + + + + +	14th mo	L m n	Fixed pupils diplopia upper and lower limbs	Moderate	Sensation impaired in extremities increased muscle pain		Mild delirium and memory impairment	Pulse 120	1 patient refused abor- tion. Prepartum de- lirium at 8th month. Child died 24 hours later	Died from exhaus- tion in 8th month. No autopsy
Lj 1922	26 IV	3rd wk + + + + +	3rd mo	L m n	Lower limbs	Moderate	Sensation impaired in lower extremi- ties		Disoriented and memory impaired	Hyperemesis with previous pregnan- cies. Nervous breakdown at 30 years. Pulse 120	Artificial abortion at 3rd month	Improved
Che 1921	20 1	nd mo + + + + +	2nd mo	L m n	Upper and lower limbs	Moderate	Sensation impaired in extremities	+	Irrational and con- fused	Retinal tumor pigments present Pulse 110	Artificial abortion at 14th month	Improved after abortion
Gobermann 1927	27 1	1st mo + + + + +	3rd mo	U m n I m n	Dysphagia and lower limbs	Moderate	Numbness and nerve trunk tenderness in lower limbs	+	Confused and forget- ful for re- cent events	Pulse 120	Artificial abortion at 5th month	Grew worse for 3 weeks and then improved
Wacile, Hinkle 1927	27 III	2nd mo + + + + +	14th mo	L m n	Upper and lower limbs	Moderate	Hypersaesthesia in extremities	+	Loose talk and psychosis	Pulse 81	Normal delivery	Improved after delivery
Leflore 1929	0 1	2nd mo + + + + +	3rd mo	I m n	Lower limbs	Moderate	Increased deep muscle pain		Irritable in delirium and forget- ful	Pulse 110	Normal delivery	Improved
Patten 1929	2 1	nd mo + + + + +	14th mo	I m n	Upper and lower limbs	Moderate	Hypersaesthesia and increased muscle pain in legs		Confused and dis- oriented		Artificial abortion at 4th month	Improved
Selueffer 1930	11 I	1st mo + + + + +	3rd mo	I m n	Diplopia, paralysis at vocal cords and lower limbs	Marked	Numbness in left side of face and lower limbs	+	Anxiety, de- pression and dis- oriented	Pulse 120	Artificial abortion at 14th month	Improved
Personal case No. 1	20 1	1st mo + + + + +	14th mo	I m n	Limbs ab- dominal and trunk muscles	Marked	Decreased sensation in extremities	+	Confused restless and dis- oriented	Two previous at- tacks of hysteria Optic neuritis Pulse 110	Vaginal hysterectomy at 5th month. Delir- ium and increased tem- peratures	Died immediately after operation Autopsy per- formed
Personal case No. 2	5 II	1st mo + + + + +	3rd mo	I m n	Dysphagia upper and lower limbs	Marked	Increased muscle pain and decreased sensation in ex- tremities	+	Confused and dis- oriented	Hyperemesis and muscle tenderness followed by pre- eclampsia. Optic neu- ritis and pre- eclampsia. Pulse 120	Spontaneous abortion at 5th month	Improved after abortion but died of pneumonia Autopsy per- formed
Personal case No. 3	20 IV	1st mo + + + + +	3rd mo	I m n	Dysphagia in extremi- ties up- per and lower limbs	Marked	Increased muscle pain and decreased sensation in ex- tremities	+	Confused and dis- oriented	Hyperemesis with previous pregnan- cies. Optic neu- ritis in present illness. Pulse 120	Patient's condition was so critical that an abor- tion was not warranted	Died of broncho- pneumonia 6 months. Autopsy performed
Personal case No. 4	21 1	3rd wk + + + + +	14th mo	I m n	Upper and lower ex- tremities	Marked	Increased muscle pain and decreased sensation in ex- tremities	+	Confused and firm toned	Patient was her- cynous and high- ly irritable. Pulse few 30's. Optic neuritis in present illness. Pulse 120	Artificial abortion at 14th month. 1 plus re- moved piece intact	Ample recovery fol- lowing abor- tion. She re- turned 1 year later

TABLE I.—SUMMARY OF CASES—C m d

A b ar	Age	H pe reus	M mp ma			Se copy	S h	M sym	Add	S hse ue h ry	T m
			Onse	T pe	D b	Degree					
Se		+++	d mo	Upe Lim	Upe d	M d te	N d reus		P bo	N mal d h ry	Com l ry
J b		+++	h m	Upe Lim	Upe d	f d	Spo d pas m sch pa m lo mb	+	P l	A ual bo y m ha	D d h m h A pe pe f med
Se		h	h m	Upe Lim	Upe d	M ved	D sed reus th pa han et d po ta en na m lo	+	Pulse	A ual bo h m h	R p d ec al bor so
Far u		+++	b m	Upe Lim	Upe d	Mod te	Decreased sensation in m		Pulse	N m l d h ry	R p d i y
Hor m		+++	d mo	Upe Lim	Upe d	Mod te	Decreased sensation in m			D l ed em ch f	f m l
Albe k	u	+++	th mo	Upe Lim	Upe d	Mod te	T d es m lo er			A ual bo m th L a f u a deli et d	h m m b k f
Albe k		+++	h mo	Upe Lim	Upe d	Mod te	D sed reus d ry unk lo er h m			N m l d h ry	h m d
Albe k		+++	d m	Upe Lim	Upe d	Mod te	D sed reus m h m			A ual bo m h L a f u a deli et d	h m m b k f
Albe k		+++	d m	Upe Lim	Upe d	Mod te	Decreased sensation in m			A ual bo m h L a f u a deli et d	h m m b k f
Kru		+++	m	Upe Lim	Upe d	Mod te	N m ed			A ual bo m h L a f u a deli et d	h m m b k f
Kr o		+++	th mo	Upe Lim	Upe d	Mod te	A sensory p m			F d d d 5th m m h	h m m b k f
Mills		+++	th mo	Upe Lim	Upe d	Mod te	Sensation in m			A ual bo m h L a f u a deli et d	h m m b k f
		+++	mo	Upe Lim	Upe d	Mod te	Sensation in m			A ual bo m h L a f u a deli et d	h m m b k f
		+++	mo	Upe Lim	Upe d	Mod te	Sensation in m			A ual bo m h L a f u a deli et d	h m m b k f

TABLE V—ONSET OF PARALYSIS

	Cases	Per cent
Month	0	0
First	2	4
Second	17	33
Third	16	31
Fourth	6	11
Fifth	6	11
Sixth	2	4
Seventh	2	4
Eighth	1	2
Ninth	1	2
Total	52	100

Lindemann described the pathological findings of Solowiet's case. We have had the opportunity of making postmortem examinations, in 3 cases, bringing the number of autopsied cases to 9.

The absence of gross anatomical changes is striking. The thoracic and abdominal viscera are normal or show only cloudy swelling and mild fatty changes in the liver and kidney.

The brain, spinal cord, and peripheral nerves are usually normal. Kast found an area of yellowish softening of the lower cervical portion of the spinal cord which microscopically showed great swelling of the axis cylinders. Dustin found a decrease in size of the larger nerve trunks.

Careful microscopic examination of the nervous system has nearly always revealed definite lesions, but even these lesions were less conspicuous than the severity of the clinical symptoms would lead one to expect. The peripheral nerves were examined in the cases of Dustin, Lindemann, Job and three of our cases. Nerve degeneration has been demonstrated in every one of these cases. Almost invariably degenerative changes are found in the anterior horn cells of the spinal cord. The changes are most marked in the lumbar portion of the cord and consist of loss of Nissl substance, swelling of the cells, eccentricity of the nuclei, and occasionally cell necrosis. These changes were present to some degree in all 3 of our autopsied cases and were reported also by Dustin, Job, and Kast. The anterior horn cells were normal in the cases of Allmann and Polk. In Lindemann's case, the spinal cord was not examined.

Petechial hæmorrhages formed a rather prominent part of the pathological picture in each of our 3 cases. These lesions were found

TABLE VI—FREQUENCY OF COMMON CLINICAL SYMPTOMS

	Cases	Per cent
Paralysis	52	100
Hyperemesis	40	76
Mental symptoms	34	68
Sphincter disturbance	20	52
Tachycardia	25	50

TABLE VII—MANNER OF TERMINATION OF PREGNANCY

Month of pregnancy	Induced abortion	Spontaneous abortion
First	0	0
Second	0	0
Third	3	0
Fourth	10	0
Fifth	13	3
Sixth	0	2
Seventh	1	1
Eighth	0	2
Ninth	1	0
Total	28	8

Normal delivery in 13 cases

in the spinal cord in Case 1, and in the brain in Case 3. In Case 2 the brain showed evidences of old petechial hæmorrhages. These lesions have not been noted previously. However, Kast and Allmann were the only 2 to examine the brains of their cases besides ourselves. It is possible that more extensive search would reveal petechial hæmorrhages more frequently.

We may conclude that the characteristic lesions of this condition are degenerative changes of the peripheral nerves and anterior horn cells, and petechial hæmorrhages in the brain and cord.

PROGNOSIS AND TREATMENT

The mortality of this condition is about 25 per cent (Table VII). This mortality rate can be reduced considerably, if the presence of toxæmia is recognized earlier, and if pregnancy is interrupted. The high mortality of the writers' 4 cases is probably due to the failure to recognize the presence of the toxæmia early. In all of these cases the diagnosis was considered as being of functional origin, and the patients were treated with the usual symptomatic treatment, such as rest, sedatives, and restriction in diet. The weakness of these patients was attributed by their physicians to the lack of nourishment rather than to actual nerve involvement.

TABLE II—INCIDENCE IN RELATION TO AGE

Age in year	Cases	Per cent
4-5	3	6
6-35	4	3
36-44	3	9
45-49	4	9
Total	4	9
Age per cent in 6 cases	46	100

TABLE III—INCIDENCE IN RELATION TO GRAVIDA

Graida	Cases	Per cent
I	9	39
II	9	9
	7	4
	5	4
		4
Total	4	4
Graida per cent in 6 cases	49	100

TABLE IV—ONSET OF HYPEREMESIS

Month	Cases	Per cent
First		55
Second	3	3
Third	3	7
Fourth		3
Fifth		
Sixth		
Seventh		3
Eighth		
Ninth		
Total	4	100

usual early complaints. Very often the complaining woman is unjustly thought to be hysterical or malingering in this stage when she is really ill. As the condition progresses it involves the abdominal muscles, diaphragm, thorax, upper extremities, and in some cases the cranial nerves. In some cases the neurological symptoms are confined to the peripheral nerves, producing the stocking glove type of anesthesia, while in others the cord is involved, producing such symptoms as sphincter disturbances (Table VI). Optic neuritis has been reported by some writers and was seen in all 4 of our cases.

Mental changes. About the same time that neurological changes appear, one generally observes definite mental symptoms characteristic of toxic psychoses as shown in Tables I and VI. Korsakow, who is credited with calling the attention of the medical profession to certain mental changes accompanying polyneuritis in alcoholism, reported with Serbski (32) similar mental changes in polyneuritis of pregnancy. The patient may be delirious, confused, and disoriented, but opportune confabulation is not common (Ely) as in alcoholic neuritis.

Laboratory findings. Urine examination shows no albumin, and the specific gravity is normal. The blood picture is normal unless some complication exists. The blood chemistry is normal. The spinal fluid is commonly negative, although a few writers have noted a slight increase of lymphocytes.

PATHOLOGY

We have been able to find in the literature reports of only 6 cases in which gross and microscopic examinations were made postmortem. These cases were reported by Kast, Landemann, Volk, Allmann, Dustin, and Job

greatest. Table III shows that the disease occurs more commonly in the first and second pregnancies. In this respect it is similar to the occurrence of hyperemesis gravidarum.

Vomiting. The vomiting usually has its onset the first 2 months of pregnancy (Table IV), which is the same time the so-called morning sickness makes its appearance. It is generally mild at the onset and indistinguishable from the ordinary type of vomiting which occurs in about 50 per cent of pregnant women. Gradually it becomes more severe and assumes the pernicious form. Not all forms of pernicious vomiting, however, are followed by nerve changes, although their appearance is identical. The vomiting in this condition rarely responds to the usual form of treatment but ceases abruptly when symptoms of paralysis first appear.

Physical findings. The patient is generally dehydrated and emaciated from vomiting. The blood pressure and temperature are not changed, but the pulse rate is accelerated to 120 or more.

Neurological findings. The first symptom of paralysis occurs most frequently in the third and fourth months (Table V). Weakness, numbness, and increased muscle pain, generally in the lower extremities, are the

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Pregnant women with hyperemesis should be repeatedly examined neurologically. As soon as neurological symptoms appear the case merits careful watching and artificial induction of labor should be considered. Although the majority of patients improve after abortion some continue to grow worse the following week or two. This is probably due to the fact that toxins still exist in the circulation and continue to affect the nervous system persisting in the same manner as the toxins from alcohol poisoning. For that reason the physician must act quickly rather than wait until the patient's condition grows critical before intervention is resorted to. Abortion is frequently deferred too long because it is usually unnecessary in most cases of hyperemesis.

Complete recovery from the paralysis does not always occur because the nerve cells are frequently destroyed. If the paralyzed extremities are not properly treated contractures frequently develop. As soon as muscle tenderness disappears active and passive movements should be instituted.

In several cases reported this condition has reappeared in repeated pregnancies. Because of such recurrence some writers have felt that this condition is identical with multiple sclerosis. The microscopic findings of the autopsied cases however show that these two conditions are different entities.

SUMMARY AND CONCLUSIONS

1. Paralysis resulting from toxemia of pregnancy has been reported under such names as peripheral neuritis, polynonitis and toxic myelitis of pregnancy. The name *toxic neuronitis of pregnancy* has been used by the writers since the nerve cells are involved as well as the peripheral nerves.

2. Forty eight cases of this condition were collected in the literature 6 of them having reports of autopsy findings. In addition to these the writers added 4 of their own cases with autopsy reports of 3.

3. This condition usually develops in the first trimester and is usually preceded by uncontrollable vomiting. The lower extremities are usually involved first. Later the paralysis becomes more extensive. Mental symptoms

of a delirious and confusional nature appeared in about two thirds of the cases. Sphincter disturbances and tachycardia were present in over one half of the cases. Opuc neuntus was present in the 4 cases observed by the writers although it was mentioned in only a few of the cases collected from the literature.

4. The blood chemistry and urine were negative in all of the reported cases. The gross findings of the autopsied cases also were essentially negative. In the writers 3 autopsied cases the liver and kidney showed microscopically a mild cloudy swelling. The microscopic study of the nervous system gave findings characterized by degenerative changes of the peripheral nerves and anterior horn cells. Petechial hemorrhages were found in a number of the sections of the brain and spinal cord.

5. This condition has been attributed to a form of autointoxication. Its appearance is similar to a severe form of the nausea and vomiting (morning sickness) which occurs in about 50 per cent of pregnancies. The weakness of the patient due to paralysis may be easily confused with weakness due to inaction resulting from hyperemesis and without careful neurological examination the condition may not be recognized.

6. The histories of the cases studied indicate that interruption of pregnancy as soon as definite neurological symptoms appear is the most satisfactory treatment. The mortality of the condition has been about 25 per cent but it is believed that this figure can be greatly reduced if the condition is recognized and treated early.

7. Although toxic neuronitis of pregnancy is comparatively rare its serious character demands attention and emphasizes the need of a thorough neurological examination of pregnant women with hyperemesis.

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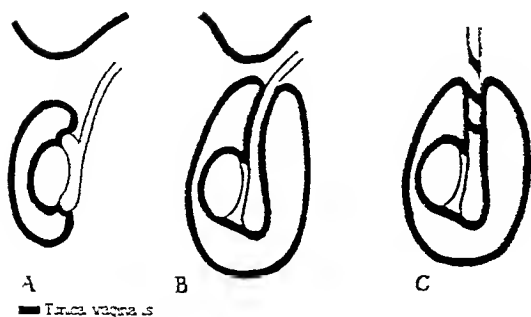


Fig 1 Vaginal sac in normal and in case of torsion A, Normal The tunica vaginalis covers the testis and anterior aspect of the epididymis B, Torsion case The tunica vaginalis extends all the way up the cord covering both testis and epididymis completely C, Testis and adnexa bulge into vaginal cavity B, Testis and adnexa hang in the vaginal cavity like a tongue in a bell C, Illustrating the low extension of the cremaster muscle in case of high investment of the cord resulting in torsion

not reduce it The earliness of operation which permitted us to obtain an excellent specimen of the infarcted testis prompted me to study the anatomy and pathology of the lesion by serial histological sections

On dissecting the normal scrotum, one finds, after the vaginal sac is opened, that it is impossible to rotate the testis markedly around its axis The reason for this is the strong attachment between the testis and the epididymis, which in turn, is attached to the inner wall of the scrotum The only possible way to rotate the testis would be to free it from the epididymis by dissection The normal anatomical situation does not permit marked lateral rotation of the testis, and it is because of this that torsion of the normally developed testis and epididymis is so rare

In order for the testis to become twisted, it must be freely movable, free from any lateral attachments, and suspended in the vaginal sac by a long stalk of the spermatic cord Such an abnormality is very rare and one must admit of some disturbance in the normal descent of the testis for this to be present

During normal descent the testis and adnexa are carried from behind the peritoneal space downward into the scrotum This is helped by the traction of a guide, the gubernaculum, which, while shortening, brings the organs down into the scrotum and keeps them there by the development of strong surround-

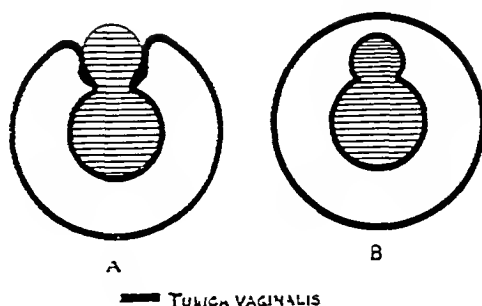


Fig 2 Cross section of the scrotum in normal and in case of torsion A, Normal, the posterior aspect of the epididymis is not covered by the tunica vaginalis, but is adherent to the inner wall of the dartos, preventing any lateral movements B, Torsion case testis, and epididymis are freely movable in the vaginal sac, making rotation possible

ing attachments The tunica vaginalis, an extension of the peritoneum, normally becomes obliterated from its abdominal opening to the proximal portion of the testis The latter becomes nearly completely covered with peritoneum by invagination while the epididymis is covered chiefly on its lateral aspect The posterior portion of the epididymis remains outside of the vaginal sac and is never covered, becoming adherent to the inner wall of the scrotum (Fig 1A)

In torsion cases, an entirely different situation is found While the actual descent remains the same, the relations of the organs to the tunica vaginalis are different During descent, or perhaps after the testis has reached the entrance to the scrotum, the testis and adnexa begin to bulge into the vaginal process For some reason, perhaps because of a lack of downward pull, this process continues until the tunica vaginalis of the testis completely surrounds the testis and epididymis When this occurs a portion of the spermatic cord likewise is invested with peritoneum above the testis The testis, epididymis and the distal spermatic cord together become an intravaginal body, hanging freely in the vaginal sac No lateral attachments between scrotum and testis and epididymis are formed This condition is permanent The obliteration of the vaginal process of the cord above this, proceeds normally until there remains only the independent vaginal sac of the testis with its visceral and parietal layers, with the

THE PATHOLOGICAL ANATOMY OF TESTICULAR TORSION

AN EXPLANATION OF ITS MECHANISM

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TORSION of the testicle frequently called torsion of the spermatic cord has long been recognized as a clinical entity. Its symptomatology has been adequately described, its etiology surmised and certain of its pathological aspects studied. The condition is caused by a sudden twisting of the spermatic cord which constricts the vessel of the cord causing acute circulatory disturbances of the testis and adnexa. If the twist is not reduced immediately the structures distal to the lesion become gangrenous. If infection does not supervene the aseptic gangrene is subsequently organized into a mass of fibrous tissue leading to complete disappearance of testicular and epididymal tissue.

The twist may occur either inside the tunica vaginalis intravaginally or outside of it extravaginally. In intravaginal torsion only the testis and epididymis are affected while in extravaginal torsion the tunica and its contents are involved. Only a few cases of extravaginal torsion have been reported. It is said to be found in cases in which the testis is arrested during its descent either within the abdomen or inguinal region. In reviewing the literature of so called extravaginal torsion it has been found usually in cases in which an incarcerated hernia had been suspected and at operation a congested and swollen ectopic undescended testis was discovered. The description of the pathology encountered in the reported cases makes one suspect that the lesion is the result of pressure rather than a true torsion of the spermatic cord. Some of the reported cases have been operated on late after complete atrophy and fibrosis had taken place and it has been assumed that torsion had occurred at an earlier date. From the description of the cases of extravaginal torsion in the literature we are not convinced that real torsion is the etiological factor. Lowesley has stated that to his knowledge there is no

reported case of true extravaginal torsion in the literature except the case of Taylor. From a study of the report of Taylor's case it seems quite possible that it was one of intravaginal torsion.

Young states that extravaginal torsion occurs only when a severe external force tears the undescended testis from its scrotal attachments. In order to make such torsion possible the loose areolar connections between the external surface of the undescended testis and the surrounding tissues must be broken especially the connection with its main attachment the gubernaculum. The trauma necessary to produce such torsion and the meager unconvincing literature on extravaginal torsion makes one doubtful as to its actual occurrence. I am therefore using the term

torsion of the spermatic cord for those cases in which no prior traumatic disturbance or ablation of tissues has occurred and where at operation no change in the topographical anatomy is found except for the actual torsion of the testis and adnexa in their normal anatomical position.

The problems which confront us in this study were numerous. Can a normal testis be twisted around its axis and if this is not possible what are the anatomical relations found in cases of torsion? What is the motive force causing the actual torsion and if a force of such a nature is found is it possible to demonstrate that it was really this force which caused the testis to become twisted?

I was fortunate in having operated upon a case of torsion of the testis comparatively early that is 18 hours after onset. The case has been reported elsewhere (9). At operation an intravaginal twist of the spermatic cord cutting off the blood supply of the testis and adnexa was found. These structures were hanging freely in the inguinal sac like a clapper in a bell (Fig. 1B). The twist as held firmly in position and gentle force would



Fig 5 Specimen removed at operation in Case 2 showing torsion of the spermatic cord in an unrotated testicle with high investment, the testis and adnexa hanging freely in the vaginal cavity

mesorchium keeps the testis at a distance from the epididymis. The high investment of these organs and complete envelopment by the tunica vaginalis causes the epididymis to be freely movable and lacking of any attachment posteriorly. The absence of the gubernaculum has never been proved (Campbell), it probably will always be found when looked for. It often appears as a string of tissue on the lateral posterior side of the vaginal sac. The early high investment of the testis and adnexa causing what to all intents and purposes is an actual disuse atrophy of their abandoned guide.

These deviations from the normal syntropy of the testis and epididymis can easily be explained as the result of the early high investment of the testis, adnexa, and cord. Normally during descent the testis and epididymis rotate together on their axes turning the lower pole of the testis outward and upward, completing a rotation of 180 degrees, the lower pole becomes the permanent upper and the upper pole the permanent lower. The

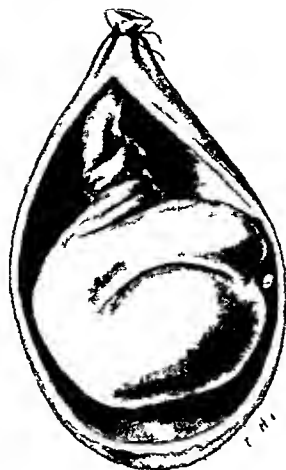


Fig 6 Specimen removed at operation in Case 1, showing torsion of the spermatic cord in a normally rotated testicle with high investment, both testis and epididymis hanging freely in the vaginal cavity

epididymis follows the same 180 degrees turn together with the testis, the lower end of it becoming the upper end or the globus major, while the upper end becomes the permanent tail or globus minor of the epididymis.

Any interference with this physiological rotation, as in early high investment of these organs, must produce situations in which the relative position of these organs will be found in any stage of rotation. The epididymis will either have only one pole, as in our case, or can be found to have completed the turn or remained in any position midway between these two. The high investment of these organs fixes them in the position found at the time this investment occurred and keeps them there permanently.

It would seem reasonable in view of what has been said to assume that torsion of the testis and adnexa depends on the freedom of these organs to twist. This freedom is accomplished by the high tunical investment. Instead of being a partially intravaginal body, the testis and adnexa become completely invested by the tunica vaginalis long before the descent is completed. The final stage of the descent is made as a body within a sac. The organs invaginated early will not complete the physiological rotation of testis and epi-

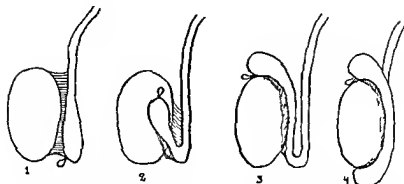


Fig 3 The physiological state of the testis and epididymis in the normal condition. 1. Normal state. 2. State of torsion. 3. State of fixation. 4. State of reflection.

organs (testis epididymis and part of the cord) suspended in it. This is especially noted in cross sections of the scrotum (Fig. 2) where instead of only partial investment as in the normal one finds in the cases of torsion a completely enveloped testis and epididymis.

The reflection of the tunica vaginalis to the testis in the cases of high investment of the cord occurs only at the highest point of the vaginal sac. This is clearly noted in the gross specimen and is also demonstrated in the serial microscopic sections of the entire scrotum.

A study of the literature of these cases convinces me that high investment of the testis and adnexa was present in every reported case. Various expressions are used by different authors to describe this high investment: Twist above the epididymis (Birdsall), intra vaginal twist (Ledington), the tunica vaginalis extends high upon the cord (Campbell), float

ing testicle (Lauenstein) like the heart in the pericardium (Labayville), dangling testicle (Rigby and Howard), intratunical pedicle (Scudder), the cord inserts like a stalk of an apple (Taylor) and dangling in a hazardous and unsupported manner (Meltzer).

The presence of other abnormalities observed in torsion cases has frequently overshadowed the most important part of the pathology of torsion, the high investment of the testis and adnexa. The anatomical abnormalities encountered are well summarized by Meltzer. He collected about 9 variations from the normal as reported in the world literature: (1) a very roomy tunica vaginalis; (2) an open tunica vaginalis; (3) absence of the gubernaculum testis and posterior mesorchium; (4) absence of scrotal ligament; (5) abnormal attachment of the common mesentery and vessels to the lower pole of the testis and to the globus minor of the epididymis so that the testis is attached by a narrow stalk instead of a broad band; (6) elongation of the globus minor; (7) excessive length and poorly attached intravaginal spermatic cord; (8) loose and mobile connection between the testis and epididymis; and (9) loose connections between the scrotal contents and the tunica.

These abnormalities are frequently encountered, being more or less pronounced in a given case. They are not of such a character as to affect the organs properly, the difference being as to the relative topography of the organs concerned, causing a lengthening or shortening of their connecting links. All

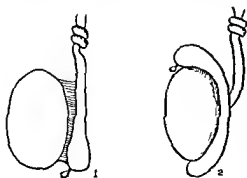


Fig 4 Illustrations of the testis and epididymis in cases of torsion and fixation. 1. Torsion. 2. Fixation.

(Fig 5) Two wax models were made, one showing this muscle on a twisted cord and the other on an untwisted cord (Figs 4 and 5)

The relative topography of the cremaster muscle in this case of torsion appears very significant in that it apparently holds the key to the second etiological factor in torsion of the testis. Although the cremaster topography appears the same as in the normal, its relative topography due to the high investment of the spermatic cord is changed. Instead of extending over the outer part of the vaginal sac, as in the normal, in cases of torsion, because of the high investment, the cremaster fibers are carried down into the inner part of the vaginal sac to the lowermost point of the spermatic cord. On sections the muscle can be traced all the way down to the testis (Fig 6)

In a case of torsion the cord, testis and epididymis form a single movable body in a roomy vaginal sac. The cremaster muscle cannot pull one part of this movable body without affecting the other. A strong contraction of this muscle will rotate the freely movable testis and adnexa. Since the reconstruction models from the serial sections showed that the cremaster muscle was in a contracted state it is indicated that this was the motive force which caused the torsion.

The major factor in torsion of the testis is the high investment of the testis, epididymis, and cord—this permits the cremaster muscle to be carried into the vaginal sac. It is evident that such a freely movable testis with a spiral muscle attached to its stalk will easily become twisted when cremaster spasm occurs.

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Fig. 1. Th. m. t. m. scle. m. l. th. m. scd. l. il. t. d. g. d. p. th. p. m. t. d. n. g. th. t. p. t. f. th. m. l. ty.

didymis remaining permanently in the position they were in before investment was completed.

High investment of the testis and adnexa however explains only one part of the problem of testicular torsion. It explains the situation which makes the rotation possible. The other problem concerns the force that actually causes the rotation and holds the structures in the abnormal position with such tenacity as often to make untwisting difficult.

It is generally believed that this force is caused by a strongly contracting cremaster muscle since this is the only contractile motive force in this region. O'Connor has observed three prominent strands of cremaster muscle reflected low down upon the cord, their origin being just above the site of the torsion.

The cremaster muscle being an extension of the lower end of the internal oblique and transversalis muscles sends fibers along the spermatic cord in the form of loops extending over the outer part of the vaginal sac (Fig. 3). A contraction of this muscle will pull the spermatic cord and with it the testis and adnexa upward making tension on the ap-



Fig. 2. M. d. l. f. th. p. m. t. c. rd. a. e. f. t. ru. alt. t. u. s. t. g. sh. g. th. p. l. b. d. f. th. remaster. m. scd. d. g. th. d. n. d. the. m. l. ca. ty.

proximal sac. Spasm of this muscle will pull the structures into the groin in cases having been described by Curling the spermatic cord in several days.

In order to determine the part played by this muscle in the case of torsion which was studied reconstructions of it were made from the serial sections. The tissues well preserved were treated with Zenker's solution and embedded in paraffin. Serial sections were made and every fifth one was mounted. These sections were stained with the special Mallory muscle and connective tissue stain the connective tissues being stained blue and the musculature red. Each section so mounted was then placed under a traveling microscope and the outline of the tissues and muscle bundles was noted on paper sheets. These drawings were later transferred to glass plates the muscle being painted red and the tissues blue. The glass plates were then placed one on top of the other completely reconstructing the spermatic cord with the twist the musculature present appearing red through the glass block.

The topography of the cremaster musculature was then transferred onto a rubber cord the cord having been twisted the same as the spermatic cord. On untwisting this rubber cord the cremaster appears in the form of a braid band surrounding the cord like a spiral

in the two animals, only the protocol of the first animal will be given

Preanæsthetic emotional disturbance. The animal had been brought upstairs to the operating room in a cage, a maneuver to which we had accustomed him by carrying it out on the 3 days prior to operation; however, when he saw the syringe being prepared and four or five people standing about, he became aware at once that something was wrong and flew into a tantrum, screaming, kicking, and exhibiting the characteristic tactics of a crying chimpanzee—at first his lips were extended as though about to suck, then the lips were drawn back with the mouth open, teeth showing, and he shrieked at the top of his lungs, this alternation of grimaces continued for 4 or 5 minutes during which time there was extensive involuntary defecation. At 9 04 the animal shrieked two or three times and then vomited, at first unproductively and eventually he brought up a considerable quantity of yellow fluid which he caught in his hand and promptly re-swallowed.

Injection, December 3, 1930, 9 07 a m. The animal was caught by five men and held while 5 cubic centimeters of dial (Ciba) was injected intraperitoneally into the left side of the abdomen. As his weight was 12,650 grams this amounted to a dose of approximately 0.35 cubic centimeter per kilogram (10 per cent solution).

Induction. The protocol giving the details of the gradual induction is as follows:

9 07 Injection, no obvious effect after 3 minutes, no screaming or hyper excitability

9 10 Put its arm out to be scratched

9 13 Still alert and looking around to satisfy his curiosity on hearing any sound

9 14 Peered out of the edge of the cage to observe who was coming in the door

9 15 Perhaps a little unsteady. Leaning against the back of the cage. No excitement

9 16 Head a little unsteady. Pupils dilated somewhat. Apparently has difficulty in fixing on an object. Grasped one's hand on putting it into the cage

9 17 Head definitely unsteady and falling toward the front of the cage

9 18 Cage opened

9 19 Again looked out at someone coming in the door

9 20 Started to lie down in the bottom of the cage

9 21 Got up and walked out of the cage, turned around and ran back again. Definitely unsteady in locomotion

9 22 Lay down in the bottom of the cage making himself comfortable with his head on his left elbow

9 23 Completely stretched out. Respiration increasing in rate

9 24 Respiration 42. Eyes shut. Moving hand

9 25 Completely quiet. Respiration deeper

9 26 Raised his head on hearing a sound and then dropped off again

9 28 Respiration 33. Much quieter

9 40 Still quiet and thought sufficiently deeply anesthetized for shaving of the head. Respiration 30

9 50 Animal woke up when his head was being shaved and an additional cubic centimeter of dial was given. After this dose the animal gradually became more deeply anesthetized, and at 10 00 it was possible to begin shaving.

10 10 Withdrawal reflexes were still present, and it was evident that we could not well proceed with an operation at that depth. The animal was weighed a second time.

10 23 An additional cubic centimeter of dial was given, making a total of 7 cubic centimeters, that is, at this morning's weight, 0.55 cubic centimeter per kilogram. After this the anesthesia gradually became deeper.

10 30 Placed on the table at which time there was still some shivering and slight movement of the hands and shaking of the neck muscles when iodine was applied to the scalp, but ether was not required at any point, and one gained the impression that during the operation the anesthesia became progressively somewhat deeper. Toward the end there was slight movement of the shoulders as we were approximating the skin. On three or four occasions during the operation he coughed, apparently from mucus that had collected in his trachea. The anesthesia on the whole was entirely satisfactory and just the desired depth. Blood pressure appeared to remain fairly high throughout as there was active oozing on all surfaces during closure.

It will be seen that during the first 10 to 12 minutes after the injection of dial, it had exerted no obvious effect except that the animal became quiet and had no further emotional disturbance. There was no period of excitement at any stage. The respiratory rate remained unchanged and ultimately at the end of 15 minutes the animal gradually fixed himself comfortably in his cage and laid down to sleep, resting his head on his left forearm. His eyes gradually closed, but even at the end of 40 minutes he could still be aroused by vigorous stimulus, after being aroused, however, he dropped off again quickly in apparently normal sleep. At the end of 50 minutes the anæsthetic had exerted nearly its full effect and was supplemented in order to abolish all spontaneous movement.

The reflexes under anesthesia were of some interest. The knee jerk and withdrawal reflexes became gradually abolished, but reflex coughing persisted throughout as did also the corneal reflexes. Shivering was in abeyance and at the end of the operation (8 hours after

OBSERVATIONS ON THE RESPONSE OF THE SAME CHIMPANZEE TO DIAL AMYTAL AND NEMBUTAL USED AS SURGICAL ANÆSTHETICS

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In human beings one cannot well compare in the same individual the effects of closely related anesthetics and it has therefore seemed worth while to report a series of such observations on a chimpanzee. In studying the problem of surgical anesthesia in primates we have recently had occasion to administer the barbituric acid derivatives dial amytal and nembutal to a large chimpanzee for three successive major surgical operations separated from one another by intervals of 1 to 2 months. We look upon the reactions of this animal as particularly significant since the chimpanzee in its neurological behavior (2) and in its response to drugs approaches the human being more closely than other primates such as the baboon or monkey.

The subject of the study was a white faced male chimpanzee, aged 4 to 5 years corresponding with the variety designated by Elliot (1) *Pan leucopymnus*. It had been under observation for 3 months prior to its first operation and was in excellent health throughout that period. Full details concerning the three operations are given in our monograph on the Babinski response (2). As far as we are aware this was the first chimpanzee upon which a surgical operation had been performed under

an anesthetic of the barbituric acid group. We might say parenthetically that the drugs offer an almost ideal anesthetic for neurological work on primate for in a series of nearly 200 operations on monkeys, baboons and chimpanzees we have had only three fatalities (two monkeys and a baboon) attributable to the narcotic. In two instances the dose had been considerably increased owing to the failure of the calculated dose to take hold with the accustomed promptness. The special advantages of individual barbituric acid anesthetics will be discussed below.

DIALLYL BARBITURIC ACID (DIAL CIBA)

The advantages of dial as a general anesthetic for neurological operations on animals (dogs, cats and monkeys) have been described at length by Fulton, Liddell and Ruch (4). We are able to confirm their findings and have now extended them to include chimpanzees. We have made one further significant observation, namely that in very dry atmospheres animals take considerably longer to recover than in moist atmospheres owing presumably to the increased loss of fluid through the lungs and skin, thus in the Thames valley in England monkeys generally recover from dial in 16 to 20 hours whereas animals of the same species with the same dose made up in exactly the same way require 24 to 30 hours. When the drug is administered in the excessively dry central heated laboratories at New Haven. With cats the difference is even greater and if no fluid is given they may require 3 to 4 days to recover fully from a calculated dose. Further observations on the influence of humidity are in progress.

We propose now to describe the reaction of our chimpanzee to dial. The observations have been confirmed in a second animal of about the same age and species but as the rate of induction and recovery was nearly identical



Fig. 1. Time of induction and recovery from dial anesthesia. The chimpanzee was given a calculated dose of dial amytal (1.5 g.) and recovered in 16 hours. The chimpanzee was given a calculated dose of dial amytal (1.5 g.) and recovered in 24 hours.

very gentle pinch of the sole caused a vigorous hamstring jerk. It would seem that this reaction had been held in abeyance while the animal was awake and emerged as a primitive form of response while narcotized. The left hind limb showed no response whatsoever either of toes or hamstring muscles, it was relaxed and motionless.

8 32 to 8 35 Reactions of the right and left toes still unchanged, animal scarcely responding at all. Respiration regular. Some shivering. Pulse strong.

9 03 On the table ready for operation but occasionally moving his hand and responding by turning his head when his ear is pinched. 1 cubic centimeter sodium amytal given, making a total dose of 7 cubic centimeters, i.e., 52 milligrams per kilogram.

9 15 1 cubic centimeter sodium amytal given.

9 30 Animal still rather too light and an additional cubic centimeter of sodium amytal was given. After this he quieted down and the anæsthesia became fairly deep. His respiration throughout the operation remained regular, somewhat more shallow than normal, and increased in rate toward the end. There was no movement, except during the stimulation of the cortex, and no vocalization, no respiratory difficulty. The heat center had evidently been disturbed for there was no shivering during the operation and the body temperature gradually diminished, being 36.1 degrees at the end (3 00 p.m.).

With an initial dose of 44 milligrams per kilogram of body weight, between 7 and 8 minutes elapsed before the animal was "down," but it had begun to show obvious effects of the drug 3 to 4 minutes after the injection. When dial was used the animal had appeared quite unaffected even at the end of 12 minutes, and it was more than 20 minutes before it was "down."

The dose of amytal had to be supplemented ultimately to 65 milligrams per kilogram. This proved entirely adequate for the whole procedure, and as with dial, it caused no appreciable depression of excitability of the motor cortex. With neither drug was there a period of excitement during induction, and in the early stages the animal in each case went through all of the rather striking preliminaries of arranging itself for sleep. In the second chimpanzee which received sodium amytal induction lasted also 6 to 7 minutes and the ultimate dose (greater than was necessary) was 70 milligrams per kilogram.

The speed of recovery from sodium amytal stands in about the same relation to dial as the speed of induction, as is evident from the following protocol.

Recovery. The stages of recovery from the sodium amytal after the second operation are indicated as follows in hours.

1st hour Induction

3rd to 7th hour Operation

8th hour Deep, breathing regularly, all reflexes abolished, continuous temperature readings obtained from the rectum.

9th hour X-rayed, slight spontaneous movements of hands and at 5 10 p.m. definite vocalization, temperature only 96.8 degrees.

11th hour Temperature 99 degrees.

12th hour Temperature 100 degrees, spontaneously raising his head (8 10 p.m.), opening his eyes and moved his arm, but quickly dropped off again, reflexes had returned in right lower extremity.

13th hour Temperature 101 degrees, on supporting his head (9 30 p.m.) he was able to drink 300 cubic centimeters of milk and then dropped off to sleep. Reflexes more vigorous than at 8 00 p.m.

24th hour Temperature normal, sitting up, moving about fairly actively, but looking a little subdued, taking food and fluid freely.

31st hour Much more alert, movement quicker, animal obstreperous and protesting. All effects of anæsthetic were now quite worn off. Feeding freely, eating a large apple without evidence of discomfort in temporal muscle.

The recovery from sodium amytal thus followed a course similar to that seen in human beings subjected to this anæsthetic, i.e., the chimpanzee was able to drink at the end of 13 hours and was sitting up after 24 hours. At the end of 30 hours, all effects of the anæsthetic had disappeared. There was no stage of excitement during recovery and nothing to suggest despondency or mental depression after the immediate effects of the anæsthetic had worn off. Respiration was materially depressed, and the heart was not embarrassed.

NEMBUTAL

Nembutal (sodium ethyl-1-methyl butyl-barbiturate), one of the new barbituric acid derivatives, prepared by the Abbott Laboratories of Chicago, has recently been used by Lundy (6) and others (5, 7) in human beings. We had employed the drug in this laboratory for several months for operations on dogs, cats, and monkeys prior to its being used for the chimpanzee, it proved particularly satisfactory for brief procedures in which recovery was desired the day of operation. In several instances after a nembutal injection which had given profound narcosis, monkeys were sitting

after operation, but the difference in size of the pupils was very much more evident after recovery from the anæsthetic

Though monkeys have occasionally shown periods of excitement when subjected to nembutal, we did not encounter it in this or the other chimpanzee to which the drug was given, and we did not observe a period of excitement during recovery. Another chimpanzee which received nembutal drank water after 6 hours and was up and about at the end of 10. The observations are in harmony, therefore, and indicate that the rate of recovery from nembutal is nearly twice as rapid as from sodium amytal.

DEDUCTIONS

Since the preceding observations were all made upon the same chimpanzee, and since we secured approximately the same depth of anæsthesia with each drug studied, we believe that the results allow us to make an accurate comparison of the properties and virtues of the anæsthetics used.

Dial can be recommended for any operation on monkeys or higher apes in which it is desired to keep the animal quiet for several days after the operation. For 24 hours it is likely to remain deeply narcotized, after which it is usually dazed for a further 18 to 20 hours, during which time, however, it will take fluids freely by mouth without evidence of fear or protest. This is particularly advantageous in ferocious animals, which with other anæsthetics are likely to make sudden movements dangerous to their wounds and to the examiner. In view of the very long postoperative stupor, we are not of the opinion that dial would be satisfactory as a surgical anæsthetic for human beings, but we are convinced that it could be used with complete safety, and perhaps to advantage, in certain cases of maniacal excitement. The liquid preparation of dial (Ciba) can be used in chimpanzees in doses up to 0.55 cubic centimeters per kilogram of body weight, being thus somewhat greater than the dose required for monkeys (0.45 cubic centimeter).

Though we have lost a chimpanzee as a result of a pulmonary embolus following amytal anæsthesia, we believe that this acci-

dent was fortuitous and that sodium amytal is a safe anæsthetic for chimpanzees and other primates. It is to be recommended if one desires to have the animal up and about within 24 hours. The dose for a chimpanzee appears to lie between 50 and 70 milligrams per kilogram; a dose of 65 milligrams intraperitoneally having been followed in the present animal by recovery in 14 hours.

Nembutal is an almost ideal anæsthetic, administered intraperitoneally, in all cases in which the operation is not to last longer than 2 hours and in which rapid recovery is desired. Induction is generally complete in 5 to 6 minutes and recovery usually occurs in as many hours, using a dose of 35 to 40 milligrams per kilogram of body weight.

SUMMARY

The barbituric acid derivatives, known under the trade names, dial, amytal, and nembutal, have been used extensively as surgical anæsthetics for neurological operations (monkeys, baboons, and chimpanzees), their properties have been contrasted and exemplified by a careful analysis of the responses of the same chimpanzee to each of the three drugs used as anæsthetics for three major neurological operations, separated from one another by periods of 1 to 2 months. The results of this study may be summarized as follows:

	Dose (per kg.)	Induction (minutes)	Recovery (hour) Swallowing	Up
Dial (Ciba)	55 mgm	25	30	48
Sodium amytal	65 mgm	8	13	20
Nembutal	40 mgm	5	0	10

The advantages of each of the anæsthetics have been summarized briefly in the discussion. Nembutal, though an ideal anæsthetic for a brief operation, is unlike dial and amytal in that it depresses the excitability of the motor cortex.

Recovery from the barbituric acid anæsthetics takes place more rapidly in a moist than in a dry atmosphere.

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up drinking water within 4 to 5 hours. We observed that nembutal differed from dial and amytal in that it produced a fairly marked depression of the excitability of the motor area in anesthetic doses (3) and it is therefore not suited for investigations requiring faradic stimulation of the cortex. We have since observed that it occasionally causes very marked excitement both in dogs and in monkeys during the early stages of induction. We are inclined to attribute this to depression of the cortex prior to its affecting the hypothalamic centers.

As our chimpanzee seemed quite recovered from its second operation at the end of 3 weeks and as we wished to give a demonstration of Horner's syndrome to the classes in physiology, the left cervical sympathetic chain was removed under nembutal anesthesia. The details of the administration of the drug are as follows:

1 d c t F b r r y 1 937 2 48 The animal as held in the usual way and a dose of 3 milligrams per kilo gram of nembutal was administered intraperitoneally. The dose was slightly less than that previously used because of the monkey's weight.

48 Injection N effects were evident in 5 minutes.

5 Animal in its cage looking about still apparently unconscious.

13 Faint signs of unconsciousness evident down the bottom of the cage lying on his side in a comfortable position.

13 Still ear a good hearing to him back late had the abdomen.

53 Milk diet all morning.

54 Completely relaxed in the epidural anesthesia. On lifting him the examining table it was noted that he had lost consciousness. In the 5 minutes after the operation he was still unconscious.

58 Deep muscular relaxation of the respiratory apparatus. The animal was still unconscious.

noo Still deeply anesthetized in the morning.

art 70 Irolo dly a tiz d t pond g

oo The milk diet fed in the afternoon.

2 pm henrich had the operation.

It was found that the dog was in a state of unconsciousness and that the animal was still unconscious.

23 Second injection 3 b t m t 5 per cent nembutal making a total of 40.5 milligrams per kilo gram. After this the animal was still unconscious.

sufficient depth for the position. The left cervical sympathetic chain was removed along an inch of the ribs.

In this instance the induction with nembutal ran a course very similar to that with sodium amytal, being slightly more rapid particularly between the fifth and sixth minutes. At the end of the sixth minute the animal was in deep surgical anesthesia, whereas this degree of anesthesia did not appear until about the eighth or ninth minute after a similar dose of sodium amytal. The respiration was somewhat more depressed and shallow but there was no difference evident in the general effects of nembutal on the circulation. In dogs, cats and monkeys we have observed rather a marked vasodilatation of the cutaneous vessels 7 or 8 minutes after injection of nembutal but this gradually passes off. The very great speed of induction and the effect on respiration appear to be the only alarming features of the anesthesia. We have used the drug repeatedly in doses up to 45 milligrams per kilo gram with only one fatality (a mature baboon which had sudden cessation of respiration 3 hours after the drug was given) but we feel that a valuable animal under nembutal should never be left without nursing care until it begins to show signs of recovery.

Our observations on recovery from nembutal are less complete than in the case of the other two anesthetics. Most animals, e.g., monkeys and baboons, appear to recover within about half the time required after sodium amytal.

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t t l f 4 5 milligrams per kilo gram) 3 d t 5th hour Ope to

6th h Still sleeping peacefully but m n t of th h nd ld be bt d o g u

t m l t n 8th h R p o t d t l a s p b t f r t n a l y

th m l a not stimulated. th h u l u l l y o c d f m t a th t c

l t t th n s g f m e n t d p s a r i g u t k g d d r i Th a m l c h b t e d

a m a k d l f t d e d i f r e r s s y d o m e m m d t y

work of Schonborn, who alleged that a glycosurea could be produced by injection of glucose per rectum. Reach, in 1902, had investigated the change in respiratory quotient after rectal injections of glucose and had come to the conclusion that it was absorbed, although slowly. Hari and Halasz, in 1918, showed a rise in respiratory quotient after rectal injections of glucose in dogs in whom the small gut had been completely ligated off from the large bowel, and state further that an actual glycosurea may be produced in this manner. Ornstein, in 1918, adopted the washing out method, in his investigations on rectal feedings on dogs, and showed that at least some absorption takes place and asserts that if glucose be given with starch, a complete absorption will take place. Tallerman, in 1919-20, working on 8 patients, concludes that glucose is absorbed by the colon although much slower than by mouth. Levi noted that a small rise of the blood sugar took place in 11 of 16 patients that received glucose retentions. McNealy and Willems, in 1929, noted that very little if any absorption took place from the colon in dogs.

In the present work, 21 solutions were finally chosen to compare for the work which was to be done on the dog and the human. We did not accept all of the solutions suggested in the questionnaires because we believed that the concentrations which we used were representative and that conclusions as regards those offered could be drawn from our work.

The following solutions were used

- ½ Per cent sodium bicarbonate
- 1 Per cent sodium bicarbonate
- 2 Per cent sodium bicarbonate
- ½ Per cent sodium bicarbonate in 1 per cent glucose
- ½ Per cent sodium bicarbonate in 5 per cent glucose
- 2 Per cent sodium bicarbonate in 5 per cent glucose
- ½ Per cent glucose
- 1 Per cent glucose
- 5 Per cent glucose
- 5 Per cent glucose
- ½ Per cent calcium chloride
- 0.7 Per cent sodium chloride
- 0.9 Per cent sodium chloride
- Dextrin solution
 - Dextrin, 100gm
 - Sodium chloride, 2½gm
 - Alcohol, 5c cm
 - Water, 300c cm
- Tap water
- Distilled water
- Locke's solution

Ringer's solution

- Commercial water solution
- Disodium phosphate, 0.03gm
- Potassium chloride, 0.01gm
- Sodium chloride, 0.06gm
- Sodium bicarbonate, 0.57gm
- Calcium bicarbonate, 0.07gm
- Magnesium bicarbonate, 0.01gm
- Water to 100 cc cm

10 Per cent dextrin in 0.9 per cent sodium chloride

Peptone solution.

- Witte peptone, 60gm
- Sodium chloride, 2½gm.
- Alcohol, 9c cm.
- Water, 300c cm

EXPERIMENTAL WORK ON DOGS

Acute conditions The animals for experiments in acute conditions were invariably given enemas of warm tap water about 1 hour previous to the experiment in order to empty the bowel. We realize that here we may have introduced an element of error but since all dogs were treated alike the latter is perhaps equalized. The enema was given rather than waiting until the animal was narcotized to clean the feces out of the bowel because it was realized that the removal of the hard excreta would traumatize the bowel. Sodium barbital anesthesia by the intramuscular route was chosen because of the small amount of water necessary to dissolve it, thus making it preferable to the oral route and the greater required volume of water. The peritoneal route was discarded because it was noted that a considerable amount of peritoneal effusion takes place subsequent to the injection. Intravenous infusion on several occasions rendered the animals useless by shock, hence was not used.

We chose sodium barbital (in doses of from 200 to 275 milligrams per kilogram) for our work rather than ether because of the necessarily long period of experimentation—some 6 hours. The drug seemed to be ideal for the purpose. In about 95 per cent of the experiments the animal retained active reflexes throughout, including that of the cornea. The animals generally gave some indication of sensibility when the solutions were changed, in that traction on the colon was followed by cessation of respiration. In some instances it was necessary to reinforce the anesthesia with ether while the solutions were being changed. It was interesting to observe, however, that

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THE SOLUTION OF CHOICE IN PROCTOCLYSIS

GEORGE LOUIS PEPUSSE JR MS MD C CAGO

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VERY little appears in the literature on the subject of proctoclysis *per se* but a host of material is present on the method of introducing the solution chosen. In view of this fact it has occurred to us that a comprehensive study of the relative merits of the various solutions suggested from time to time might be of some value. Although Lawson in 1908 made the first observations along these lines the subject was apparently dropped until 1912 when Trout published his clinical study on the comparative merits of tap water and physiological sodium chloride proctoclysters (10). Working on 400 post-operative cases regardless of the type of operation they had undergone and using the Murphy drip technique Trout noted that ordinary tap water was far better absorbed from the colon than the physiological saline. The actual results indicated that approximately 400 cubic centimeters more of tap water were absorbed per 24 hours than of the 0.9 per cent sodium chloride. He further suggests that if the recommendation of Murphy would be followed (that of pushing the clysis to 18 pints a day) the patient would absorb nearly 81 grams of the salt per diem. The latter figure is something over the normal intake for a month.

In order to ascertain the current ideas regarding the subject two hundred questionnaires were sent out to larger hospitals of the country with the request that they be filled in. The questionnaires contained lists of some twenty solutions suggested as clysters and the

staffs of the hospitals were asked to check the solutions in the order of their preference. Seventy eight answers were received and the tabulation indicated an overwhelming preference in favor of three solutions: tap water 0.9 per cent sodium chloride and 5 per cent glucose. Tap water was listed as third choice preference being about equal in regard to the two other favored solutions. During a recent tour of the European clinics it was noted that the same solutions were generally used if in deed the practice of proctoclysis was not discontinued completely in favor of hypodermodyesis or intravenous infusion. From the returned questionnaires and from personal contacts we could not fail to have it impressed upon us that the reasons for using this or that solution were often extremely vague and many of them without even clinical foundation.

At the present time a great deal of discussion centers about the subject of glucose absorption from the bowel or more properly the colon. Bremer in 1906 making comparisons of fresh and prepared specimens of the small intestine and of the colon watched the absorption of proteins and fats but says that no carbohydrates can be absorbed. He suggests protein nutrients. Nagel in 1909 states that glucose has been shown by Czerny and Latschenberger to be absorbed in patients in whom the large intestine or part of it had been completely cut off from the small intestine. He says the same results were obtained by Heile in dogs especially operated upon for this purpose. Nagel also calls attention to the

original introduction of fluid would be maintained at a constant rate of absorption throughout

The pressure used was 9 centimeters of water pressure as registered on our manometer. It was found later, in the work on dogs with chronic conditions, that this was just sufficient to overcome the intra-abdominal pressure and allow the fluid to flow in without provoking an emptying movement of the bowel.

During this and subsequent work, we have demonstrated many practical uses for the apparatus other than its special use in intestinal absorption experiments. The mechanism lends itself very readily to intravenous infusion of fluids as well as hypodermoclysis. By regulation of the output one may infuse over a period of hours with excellent results. In the infusion of blood, the samples must be citrated or defibrinated but no other precaution is necessary. Attention must be paid, however, to the level of the fluid in the bottle so that air is not introduced into the circulation.

As earlier suggested, the 21 solutions used were arbitrarily divided up into groups of 5 with no attempt to segregate the salt solutions from the glucose solutions. It was felt that in this manner we could make a more complete study.

The first group consisted of 5 per cent sodium bicarbonate, tap water, Ringer's solution, 1 per cent sodium bicarbonate and 0.9 per cent sodium chloride. The second group consisted of 1 per cent glucose, 0.5 per cent calcium chloride, 0.7 per cent sodium chloride, Locke's solution, and 5 per cent glucose. The third group consisted of a commercial alkaline water which was supposedly high in calcium and carbon dioxide, distilled water, 0.5 per cent sodium bicarbonate in 1 per cent glucose, 2 per cent sodium bicarbonate, and 2 per cent sodium bicarbonate in 5 per cent glucose. The fourth group consisted of 5 per cent glucose, 10 per cent dextrin in 0.9 per cent sodium chloride, 0.5 per cent sodium bicarbonate in 5 per cent glucose, dextrin solution and peptone solution. The results on each series will be discussed in detail. Series 5 consisted of those salt solutions which evinced superiority in

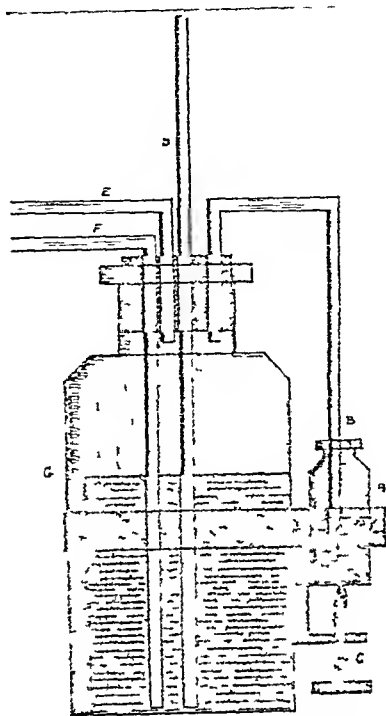


Fig. 1. A drawing of the pressure bottle used in most of the experiments. 1, the mercury bottle for overflow of air, B, air overflow tube, C, screw for raising or lowering the mercury bottle, D, water manometer, E, air intake tube, F, outflow tube to the gut, G, pressure bottle containing solution.

their respective groups. Series 6 were those glucose solutions chosen for the same reason. In the latter we were concerned with the rôle of the sodium bicarbonate as well and so used one of our poorest absorbed solutions, 5 per cent glucose, for purposes of comparison. The "series 5" experiments were run twice, the second time being a year later. The object was two fold, to determine which of the solutions was best absorbed and secondly to determine the fate of the solutes. Series 6 was also run one year later than the other experiments but it is interesting to note that the results gained are in total conformity with those of the previous year.

Unanesthetized dog experiments. Four dogs were used for the experiments in chronic conditions. The series of experiments were run for the express purpose of checking up on the results which were obtained in the acute conditions with the work done under barbital

even though our animal was in a condition approximating shock (with cold intestines, slow heart and respiration) the results were of the same general order.

A midline incision was used extending from the umbilicus to the pubes. The colon was then picked up and a glass cannula introduced in close proximity to the ileocecal valve. This was secured by a pursestring suture. A similar cannula secured by pursestring sutures was then introduced into the rectum. The small bowel was tied off at its junction with the colon. The large intestine was then flushed out with warm tap water and gently stripped and the first solution was introduced.

We realized that since we were dealing with the relative merits of various solutions the first criterion in the case of the salt solutions at least was the relative rate of absorption in regard to their fluid content. To this end we decided to run our solutions in groups of five and these were alternated in their sequence from day to day. Thus a solution which was run first one day would be run last the next day and the others would advance toward the top of the list. After five experiments when each solution had been run first at least once the order was completely reversed and another five experiments performed in the new order. We could in this manner be sure that the relative rate of water absorption or solute disappearance noted was the true criterion and was not the result of one solution senilizing the gut toward that solution next in order. We were also interested in seeing that in our experiments with glucose as much error as possible arising from the carbohydrate remaining in the bowel after washing could be eliminated.

The time interval chosen was 45 minutes for each on a given solution. We believed that in such a period any changes likely to take place could be readily demonstrated. At the end of this period the bowel was gently stripped and further exhausted of its fluid content by air pressure. The latter method of emptying the bowel used in conjunction with the apparatus to be described makes the procedure quantitative. The bowel was washed between each two solutions with warm distilled water.

We have always been accustomed to some method of stripping the gut because we have

noted that unless this is done more or less of the fluid remains to confound the results. It was also our practice in our acute experiments to wash the bowel with distilled water in amounts equal to the original solution used in order to remove the last vestige of the salt introduced. These washings were then combined with the solution taken from the gut and the total concentration worked out from the latter.

The apparatus used consisted of a pressure bottle in which was also kept the solution (Fig. 1). Air pressure from the line was brought to the bottle and maintained at a constant pressure by a mercury pressure flask. Thus the manometer in the pressure bottle was maintained at a given pressure by fixing the end of the air outlet the required distance below the surface of the mercury to keep such a pressure. Hence any change in the line pressure above that set in the bottle would cause more air to flow out through the mercury. In addition to this if the pressure within the bowel became greater than that within the stock bottle the fluid in the bowel would flow back into the latter. A drop in the pressure in the bowel due to absorption or tonus change necessarily caused more fluid to go into the bowel.

The fluids were always introduced into the bowel at 37.5 degrees C. No attempt was made to keep the stock fluid at a constant temperature because the amount going into the bowel at any one time was very small (usually at the rate of less than 1 cubic centimeter a minute into a total volume of around 100 to 150 cubic centimeters). In the case of a rapid tonus change within the bowel the amount of cold fluid introduced into the bowel was minimized by the fact that the time interval chosen did not allow the temperature ever to fall as low as the room temperature.

Our reasons for using this apparatus were many. Our chief concern was in the regulation of the pressure factor. We early recognized that on the basis of Hamburger's work our pressure value had to be constant if we were to determine true values. In addition to this we wished to have an excess of fluid over that introduced into the bowel so that we might assume that all of the mucosa reached by the

we decided to continue the analysis of the sugar solutions. The results obtained are outlined.

The described method of observation of absorption from the large bowel was chosen in preference to the closed loop because we felt that in spite of the error possibly introduced by fluid escaping from the small bowel and retained faeces after the enemas, it was far more physiological and nearer to human practice. In the closed loop method we would have to deal with a constant mucus secretion which would have to be washed out, and a constant leakage from the ileostomy opening. This of itself would introduce an error because of the disturbance to the water balance of the animal, since the function of the colon is normally to resorb the water of substances in course of digestion. A criticism may be raised on the basis that the nipple introduced shuts off the opening of the ileum into the colon and hence may conceivably cause a piling up of materials in the small bowel during the course of the experiment and in some reflex fashion alter the results from those which would otherwise be obtained. We do not believe that this is true for our animals were fed about 16 hours before the data were checked, hence the bowel was presumably free at time of experiment.

In our observations on urinary excretion, controls were run on amounts and total acidity before and during the course of the experiments. The control periods were variously from half an hour to an hour, and the excretion was calculated on the basis of 1 hour.

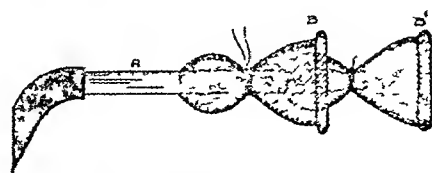


Fig. 2 Templeton's apparatus 1, Glass tube, B and B', soft rubber nipples tied over tube

The animals were kept on pads during the course of the experiments and frequently went to sleep. They were covered with towels to keep them warm and to quiet them.

By the simple expedient of providing a smaller gauge intake tube than the outlet, we were able to cause a lag in the solution going back into the bottle after a colon contraction. We then connected a water manometer to the outlet at the anus and obtained by this method a tracing of colonic activity. Thus we had an apparatus for the observation of absorption of a given solution and could determine its effect upon the activity of the bowel itself. The idea presents many possibilities of the observation of the pharmacological properties of various drugs upon the colon. Thus we can use the chosen drug either in the proctoclyster or by substituting tap water, etc., for the latter we can determine the effect of hypodermically administered solutions.

RESULTS

Acute conditions As has been previously mentioned, our list of 21 solutions was arbitrarily split up into groups of 5 for comparison.

TABLE II—SERIES 1 URINARY EXCRETION

Solution used		Experiment No										Total ave
		1	2	3	4	5	6	7	8	9	10	
5 Per cent NaHCO_3	c cm	90	95	30	60	80	100	45	140	30	00	55
	pt.	5	1	1	4	5	2	1	3	2	2	26
Tap HOH	c cm	90	20	40	10	40	60	100	170	70	50	65
	pt.	5	2	2	3	4	1	2	7	3	5	51
Ringer's	c cm	10	30	40	00	0	10	110	130	10	00	36
	pt.	1	3				5	5	5	1	2	7
1 Per cent NaHCO_3	c cm	40	60	100	80	30	160	150	110	90	0	87
	pt.	4	5	5	5	5	5	1		5	1	
9 Per cent NaCl	c cm	30	0	50	00	10	130	100	0	50	0	60
	pt.	3	7	4	1	1	4	5	1			

TABLE I—SERIES I

Seri used		F p m n										T al
		6	7	8	9	10	11	12	13	14	15	
P ce N HCO	m	5	5	5								
T I Off	cm	53	6								20	
R	cm	7		6	5							
P N HCO	cm					6		9	6	5		
I N Cl	pt.	57		5		9				6		

In the first series of experiments the animals were operated on each of the animals females being chosen for ease in catheterization. The incisions were made in the midline and the cæca were brought out through stab wounds in the left rectus the perineal operation being done at the same sitting. After the completion of the latter operation the cæcum was clamped with a long hæmostat and cut the free cut edge was then cauterized for hæmostasis and the original incision through the abdominal wall was covered with a small strip of gauze soaked in collodion. The latter rapidly dried and formed an excellent covering for the wound. Operating in this fashion we were able to complete the work in one stage and at the same time to expose the animal to a minimum of infection. Dogs so operated upon may be used in 1 week.

In series 7 and 8 the operations were those performed for chronic conditions and those solutions were used which appeared to be superior in series 5 and 6. In series 7 and 8 due to the fact that we were unable to control as accurately the amount of solution possibly absorbed it was determined to make the periods that each solution was run longer. The time chosen was 3 hours or four times the experimental period in the acute conditions. Only 2 solutions were run on each dog each day due to possible fatigue of the animals over such a long period of time. The solutions were so rotated that each was compared with the

others at least twice being run first once and then last the next time.

The experiments for chronic states were run on animals that had cæcostomy openings into the left rectus so that the muscle could be used as a valve. The ileocecal sphincter helped a great deal in maintaining a water tight system. Most of the error introduced by the leakage of fluids was eliminated by the use of Impleton's apparatus (Fig 2). This makes use of an ordinary nipple from a nursing bottle which is pierced by the glass tube. When introduced into the bowel the end flares out and combined with the pressure of the bow upon it seals the latter fairly well as far as the escape of fluid is concerned. One of these was also introduced into the anus for drainage purposes. It was noted in the course of the experiments that the same methods used with the exception of the bowel stripping in the acute conditions could be used on the animals with chronic conditions. In the latter when emptying the gut and applying air pressure it was customary to apply pressure on the dog's abdomen to force the fluids out.

In the work done with these animals it was early realized that any analysis of the salt content of the fluids drained from the bowel would be practically worthless because of the error introduced by the faeces retained in the crypts of the bowel. On the basis of our work on the glucose however (controls on distilled water)

we decided to continue the analysis of the sugar solutions. The results obtained are outlined.

The described method of observation of absorption from the large bowel was chosen in preference to the closed loop because we felt that in spite of the error possibly introduced by fluid escaping from the small bowel and retained feces after the enemas, it was far more physiological and nearer to human practice. In the closed loop method we would have to deal with a constant mucus secretion which would have to be washed out, and a constant leakage from the ileostomy opening. This of itself would introduce an error because of the disturbance to the water balance of the animal, since the function of the colon is normally to resorb the water of substances in course of digestion. A criticism may be raised on the basis that the nipple introduced shuts off the opening of the ileum into the colon and hence may conceivably cause a piling up of materials in the small bowel during the course of the experiment and in some reflex fashion alter the results from those which would otherwise be obtained. We do not believe that this is true for our animals were fed about 16 hours before the data were checked, hence the bowel was presumably free at time of experiment.

In our observations on urinary excretion, controls were run on amounts and total acidity before and during the course of the experiments. The control periods were variously from half an hour to an hour, and the excretion was calculated on the basis of 1 hour.

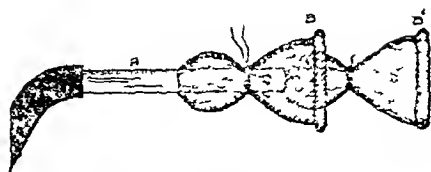


Fig. 2 Templeton's apparatus. A, Glass tube, B and B', soft rubber nipples tied over tube.

The animals were kept on pads during the course of the experiments and frequently went to sleep. They were covered with towels to keep them warm and to quiet them.

By the simple expedient of providing a smaller gauge intake tube than the outlet, we were able to cause a lag in the solution going back into the bottle after a colon contraction. We then connected a water manometer to the outlet at the anus and obtained by this method a tracing of colonic activity. Thus we had an apparatus for the observation of absorption of a given solution and could determine its effect upon the activity of the bowel itself. The idea presents many possibilities of the observation of the pharmacological properties of various drugs upon the colon. Thus we can use the chosen drug either in the proctoclyster or by substituting tap water, etc., for the latter we can determine the effect of hypodermically administered solutions.

RESULTS

Acute conditions. As has been previously mentioned, our list of 21 solutions was arbitrarily split up into groups of 5 for comparison.

TABLE II—SERIES 1 URINARY EXCRETION

Solution used		Experiment No										Total ave.
		1	2	3	4	5	6	7	8	9	10	
5 Per cent NaHCO_3	c cm	00	03	30	60	50	100	45	140	30	00	55
	pt	3	1	1	4	3	7	1	3	7		6
Tap HOH	c cm	90	0	40	10	70	60	100	170	70	30	63
	pt	3	2		3	4	1	2	4	3	3	31
Ringer's	c cm	10	0	40	00	20	120	110	180	10	00	36
	pt	1	3				3	3	3	1	-	7
1 Per cent NaHCO_3	c cm	40	60	100	30	30	160	130	110	90	40	57
	pt	4	3	3	3	3	3	4		3	1	4
9 Per cent NaCl	c cm	30	30	30	00	10	130	100	-0	30	0	60
	pt	3	4	4	1	1	4	3	1	4	3	30

TABLE III—SERIES 2

Sol used		Experiment No.								Total
		1	2	3	4	5	6	7	8	
Per 1 ose	m	5				2	6		3	
		5				5	6		5	
P C Cl	m	2				3	5	5	6	
			5				5			5
7 P N Cl	cm			5	44	2		5	0	
				5						
Lock	cm	2	6			7			3	3
	p								5	7
Per 1 se	m	—	—			—	—	—2	—	5
	p									

purposes. The odd one left over 25 per cent glucose was run in a separate series (series 7).

Those solutions which showed the best absorption rates in the early series were grouped together in the fifth and sixth series for further elimination. As may be expected the differences here are not so striking as previously. However it may be seen that 0.5 per cent calcium chloride was slightly better than the 0.5 per cent sodium bicarbonate and commercial water solutions. This group consisted wholly of the inorganic salts. The sixth group made up of glucose solutions primarily was run in an attempt to judge which of these were best suited for absorption purposes. In this series the 1 per cent glucose was best absorbed as far as fluid content was concerned and the 0.5 per cent glucose and 0.5 per cent sodium bicarbonate in 1 per cent glucose were equally well absorbed. The actual amounts of glucose absorbed per cubic centimeter followed the fluid absorption in comparatively close agreement (about 1 gram per 100 cubic centimeters in the case of the 1 per cent glucose).

A short table of comparisons of the different solutions follows:

TABLE OF COMPARISONS

Solutions used	Amount absorbed
5 per cent sodium bicarbonate	546 gm. p 4 5 m
1 per cent glucose	454 gm. p 46 gm. cr
5 per cent glucose	58 gm. p 8 gm. m
0.5 per cent glucose	66 gm. p 4 4 m
5 per cent sodium bicarbonate	75 gm. p 4 5 cm
1 per cent glucose	

Chloride and calcium determinations were run on the inorganic salts in most of the experiments of the fifth series. As may be expected the hypotonic sodium chloride solutions showed an increase in chloride content in a majority of the determinations. Calcium on the other hand consistently was absorbed from the commercial water solution although the absorption took place in only minimal quantities.

Urinary excretion was followed in the first two groups of acute experiments. As may be seen from the accompanying tables the latter showed no correlation to the amount of fluid absorbed. It was first thought that this was due to the method of administration of the hypnotic employed but it was not the case. It may be that the hypnotic in such doses had a deleterious effect in the kidneys or that the water balance of the blood and tissue was disturbed by the narcosis or that the pentantal effusion following the trauma of experimental procedure accounted for the remainder but this is doubtful. In order to come to some conclusion we decided to follow the urinary excretion in our experiments in chronic condition. The results will be discussed in that section.

In the first series an effort was made to determine whether the absorbed solutions had any effect upon the water content of the blood. To this end control samples of blood were withdrawn from the animals before the experiment and at the end of each run. The samples were weighed and allowed to evaporate.

TABLE IV—SERIES 2, URINARY EXCRETION

Solution used		Experiment No										Total ave.
		1	2	3	4	5	6	7	8	9	10	
1 Per cent glucose	c cm	30	10	70	40	60	80	50	20	100	80	64
	pt	2	1	4	3	5	3	-	3	4	3	32
3 Per cent CaCl ₂	c cm	60	15	50	70	60	30	120	10	10	70	79.5
	pt	4	2	2	5	5	1	4		1	2	28
4 Per cent NaCl	c cm	20	40	60	50	50	50	50	90	80	150	61
	pt	1	5	3	4	4	3	-	3	3	4	34
Locke's	c cm	40	20	110	00	20	70	140	60	120	80	66
	pt	3	3	5	1	3	4	5	4	5	3	36
5 Per cent glucose	c cm	100	30	20	10	10	40	110	00	70	160	57
	pt	5	4	1	2	2	2	5	1	2	5	41

rate their water content to a constant weight, the process covering 3 days. The water content of the serum plus corpuscles did vary but the results were not comparable with the absorption. In other words a solution which was relatively slowly absorbed from the bowel might show a greater water content in the blood than one which was far better absorbed from the gut. We shall attempt in this connection to make no explanation for the results.

Again, we noted no correlation between the size of the animal and the amount of the fluid absorbed. One would expect that in the larger animals with potentially a greater absorptive area, one would see a greater absorption but despite this we have noted some of the best absorption in our smallest animals. This factor may be explained on the basis of the animal's intake before the experimental periods.

Results on unanesthetized dog experiments
Series 8 and 9 consisted of 6 experiments on each four animals, the best absorbed solutions in the inorganic salts and glucose concentrations of series 5 and 6 being used. The results indicated that 1 per cent glucose is better absorbed than either 0.5 per cent glucose or 0.5 per cent sodium bicarbonate in 1 per cent glucose. The data suggest that the 1 per cent solution comes closer to the physiological optimum point than the others and that the addition of 0.5 per cent sodium bicarbonate may raise the total osmotic tension beyond the optimum level. The findings were totally

in keeping with those of the acute experiments. The data on the inorganic salt runs indicated that the 0.5 per cent sodium bicarbonate solution was slightly better absorbed than the other two solutions, making the 0.5 per cent sodium chloride the second in order whereas it had been first in the acute runs by a small margin.

As we have suggested earlier, it was decided to follow the urinary excretion in the animals with chronic conditions to determine whether this ran parallel with the absorption. Our results indicate that it does not. No attempt was made to govern the water intake of the animals because it was realized that if we had to give them enemas as was necessary under the conditions of the experiments we would introduce a great deal of error. The animals evidently absorbed water up to the point of tissue saturation before any increased excretion took place. This process did not seem to have any correlation with the comparative rate of absorption—did not affect the latter. The urinary acidity went down almost invariably as would be expected due to the dilution. The latter was measured by titration with fortieth normal sodium hydroxide and phenolphthalein.

The tabulated results of the experiments in the chronic conditions in Table X appear later. It must be remembered that here we are dealing with solutions whose concentrations are uniformly low so that the differences will not be as striking as though the concentrations were widely divergent.

TABLE III—SERIES 2

Sol. used	m	Expt. No.										Total
		1	2	3	4	5	6	7	8	9	10	
1 per cent glucose	m	5	5	3	4		5					5
5 per cent glucose	m	8		4		5	5	5	6			55
	pt						5			5		
1 per cent NaCl	cm				4	5		5	6			
	pt			5	5			5	5			5
Locke	m	8	6			7						1
	pt											
5 per cent glucose	m							5				

purposes. The odd one left over 25 per cent glucose was run in a separate series (series 7).

Those solutions which showed the best absorption rates in the early series were grouped together in the fifth and sixth series for further elimination. As may be expected the differences here are not so striking as previously. However it may be seen that 0.5 per cent calcium chloride was slightly better than the 0.5 per cent sodium bicarbonate and commercial water solutions. This group consisted wholly of the inorganic salts. The sixth group made up of glucose solutions primarily was run in an attempt to judge which of these were best suited for absorption purposes. In this series the 1 per cent glucose was best absorbed as far as fluid content was concerned and the 0.5 per cent glucose and 0.5 per cent sodium bicarbonate in 1 per cent glucose were equally well absorbed. The actual amounts of glucose absorbed per cubic centimeter followed the fluid absorption in comparatively close agreement (about 1 gram per 100 cubic centimeters in the case of the 1 per cent glucose).

A short table of comparisons of the different solutions follows.

TABLE OF COMPARISONS

Sol. used	A. g. absorbed
5 per cent sodium bicarbonate	546 gm per 45 m
5 per cent glucose	431 gm per 46 gm
5 per cent glucose	5 gm per 86 m
5 per cent glucose	695 gm per 44 m
5 per cent sodium bicarbonate	75 gm per 4 m
5 per cent glucose	

Chloride and calcium determinations were run on the inorganic salts in most of the experiments of the fifth series. As may be expected the hypotonic sodium chloride solutions showed an increase in chloride content in a majority of the determinations. Calcium on the other hand consistently was absorbed from the commercial water solution although the absorption took place in only minimal quantities.

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TABLE IV—SERIES 2, URINARY EXCRETION

Solution used		Experiment No										Total Ave.
		1	2	3	4	5	6	7	8	9	10	
1 Per cent glucose	c cm	30	10	70	40	60	30	30	20	100	80	0.4
	p		1		3	5	5	2	3	7	3	1
.5 Per cent CaCl	c cm	60	13	30	70	60	30	120	10	10	70	4.93
	pt.	4	2	2	5	3	1	4	-	1	-	-.3
7 Per cent NaCl	c cm	20	40	60	30	30	30	30	90	30	130	0.1
	pt.	1	5	3	4	4	3	2	5	3	4	3.4
Locke's	c cm	40	20	110	00	20	70	140	60	10	80	0.6
	pt	3	3	3	1	3	4	3	4	5	3	3.0
.5 Per cent glucose	c cm.	100	30	40	10	10	40	110	00	70	160	3.7
	pt	5	4	1	-	7	2	3	1	2	5	2.7

rate their water content to a constant weight, the process covering 3 days. The water content of the serum plus corpuscles did vary but the results were not comparable with the absorption. In other words a solution which was relatively slowly absorbed from the bowel might show a greater water content in the blood than one which was far better absorbed from the gut. We shall attempt in this connection to make no explanation for the results.

Again, we noted no correlation between the size of the animal and the amount of the fluid absorbed. One would expect that in the larger animals with potentially a greater absorptive area, one would see a greater absorption but despite this we have noted some of the best absorption in our smallest animals. This factor may be explained on the basis of the animal's intake before the experimental periods.

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As we have suggested earlier, it was decided to follow the urinary excretion in the animals with chronic conditions to determine whether this ran parallel with the absorption. Our results indicate that it does not. No attempt was made to govern the water intake of the animals because it was realized that if we had to give them enemas as was necessary under the conditions of the experiments, we would introduce a great deal of error. The animals evidently absorbed water up to the point of tissue saturation before any increased excretion took place. This process did not seem to have any correlation with the comparative rate of absorption—did not affect the latter. The urinary acidity went down almost invariably as would be expected due to the dilution. The latter was measured by titration with fortieth normal sodium hydroxide and phenolphthalein.

The tabulated results of the experiments in the chronic conditions in Table X appear later. It must be remembered that here we are dealing with solutions whose concentrations are uniformly low so that the differences will not be as striking as though the concentrations were widely divergent.

TABLE X — RESULTS IN CHRONIC CONDITIONS

Solution used	1st run c. cm.	2nd run c. cm.	Total absorbed c. cm.
1 Per cent glucose	432	812	1244
0.5 Per cent glucose	521	460	981
1 Per cent glucose	721	789	1510
1 Per cent glucose and 0.5 per cent sodium bicar- bonate	709	654	1363
0.5 Per cent glucose	677	729	1406
0.5 Per cent sodium bicar- bonate and 1 per cent glucose	858	660	1518
0.5 Per cent sodium bicar- bonate	836	785	1623
Com'l water	758	753	1511
0.5 Per cent sodium bicar- bonate	746	596	1342
0.5 Per cent sodium chloride	470	602	1072
0.5 Per cent sodium chloride	940	364	1304
Com'l water	844	436	1280

sodium chloride, 0.03 per cent potassium chloride, and 0.025 per cent calcium chloride. The principal constituent here is the 0.7 per cent sodium chloride and as may be readily noted by comparison of series 1, 2, and 5, the results are closely similar. Locke's solution on the other hand, having nearly the same quantity of sodium chloride in it that the physiological saline has, gives results very similar to the latter. The Locke's solution used was that originally proposed by the author.

Tap water and distilled water Tap water was shown to be superior to both the 0.7 sodium chloride and the Ringer's solutions to about the same degree, although the actual comparison of all three does not take place in any one series. Experimentally, the tap water was also far better than the 0.9 per cent sodium chloride. In 7 of 7 experiments in series 5, the tap water showed an increased chlorine content. The 0.7 per cent sodium chloride also illustrated the same phenomenon so that we may possibly assume that the results were explainable on the basis of a difference of the osmotic pressure of the bowel and the bowel content causing an extravasation of the chlorine ion into the bowel and the absorption of the water content of the clyster to equalize the pressure.

 TABLE XI — RESULTS OF CONTROLLED
EXPERIMENTS ON MAN

SERIES 10 — GLUCOSE SOLUTIONS

Solutions used	Experiment number					Total 1 per cent c. cm.	Total 5 per cent c. cm.
	1	2	3	4	5		
1 Per cent	300	300	900	100	750	990	
5 Per cent	300	180	400	780	400		-300
1 Per cent	300	400	340	360	730	330	
5 Per cent	300	400	100	600	200		1900
1 Per cent		300	700	610	900	-160	
5 Per cent		400	500	100	600		1700

Total 1 per cent glucose 3660 c. cm. Total 5 per cent glucose 3990 c. cm.

We had no adequate reason for running experiments on both the tap and the distilled water save that the latter was rarely used clinically. We make no distinction between their comparative merits.

Dextrin and peptone solutions Fantus, in his "Technique of Medication," in the portion devoted to nutrient enemas, suggests the possibilities of using dextrin as a nutrient constituent because of its non-irritability and ease of conversion into dextrose by the diastase of the bowel. He further suggests that this substance be made up in 0.9 per cent sodium chloride to adjust the osmotic tension. He quotes Carl Von Noorden for his formulae for two other nutrient enemas, one of which is carbohydrate mainly and the other of which has a peptone base. The composition of the 3 is given in the first part of the paper.

These 3 solutions were compared with 2 glucose solutions in series 4. The peptone was exceedingly hygroscopic.

Protein digestions indicated that absorption of from 700 to 900 milligrams/250 cubic centimeters of solution had taken place in our interval of 45 minutes. This was not a quantitative finding, however, because of the presence of a great deal of mucus—evidently secreted by the bowel as a defense mechanism against the infused irritant.

Of the 3 solutions, the dextrin in 0.9 per cent sodium chloride showed the best absorption of fluid, possibly explained on the basis of the water content. The results are fairly close to those of the 0.9 per cent sodium chloride alone. The fate of the dextrin solution was impossible to note because of the insolubility which made

determination results on the chronic animals and on the human were of the same order as those obtained in the acute experiments

Since no attempt was made to separate the inorganic salt solutions from the nutrients in the early series we gained an accurate standard of comparison of the relative rate of absorption of the two types of substances. In series 2, the 1 per cent glucose was definitely better absorbed than the 0.5 per cent calcium chloride and the 0.7 per cent sodium chloride. In series 3 the 0.5 per cent sodium bicarbonate in 1 per cent glucose was slightly less absorbed than the commercial product and distilled water. We prefer, however, to accept the results gained in series 6 on the basis that the differences here are more striking in the average amounts of fluids absorbed as well as in the total amounts. Here we note that the 1 per cent glucose with and without bicarbonate and the 0.5 per cent glucose are all more readily absorbed than the distilled water. *We can then perhaps come to the tentative conclusion that 1 per cent glucose solution is the ideal for restoring water balance and for supplying some degree of nutrient.*

High glucose concentrations. In our previous experiments we had come to the conclusion that high glucose concentrations defeated their own purposes by the tremendous hygroscopic effects which they displayed. We had been advised of the use of 25 per cent glucose as a small retention enema in chosen cases and were, therefore, desirous of knowing the fate of such a solution. To this end we ran a series of 3 acute experiments on dogs. Varying from our customary procedure we ran the animals on this concentration *only* for a period of 3 hours. The time then was four times as long as the usual one. We believed that perhaps some glucose would be absorbed as the dilution was increased by the bowel. Records were made of the colon contractions during 1 hour periods on each dog. The record made on the second dog of the series displayed the most interesting results. The tracing showed enormous excursions of the manometer which were readily comparable with those of the unanesthetized animal and several records of what we assumed were emptying movements when observed in the normal animal. At least

the normal dog would show uneasiness which was concurrent with a high contraction and a reflux of the solution back into the bottle. The glucose solutions are here again assumed to be irritating because of the large amount of mucus noted in the fluid drained off after the experiment.

Two of the 3 animals were under very light anesthesia and the third was in a state of shock from overdosage of barbital, yet all results were in the same order.

The animals weighed respectively, 7.4 kilograms, 7.8 kilograms, and 20 kilograms. The first animal (the one in shock) showed an increase of 73 cubic centimeters of fluid over that which was run into the bowel, the second showed 135 cubic centimeters increase, and the third showed an increase of 255 cubic centimeters. These figures become striking if, taking the total blood of the animal as being one-thirteenth of its body weight, we see that we have removed one-fifth of the figure. If it is possible to apply the analogy of dog to human, we see that a man weighing four times that of the latter dog's weight would have lost in the 3 hours, 1020 cubic centimeters of fluid. Under these circumstances, it is extremely interesting to determine what this solution would do in those patients suffering from myocardial or renal deficiency. As a proctoclyster the solution seems to be useless.

Sodium bicarbonate solutions. Examination of the accompanying tables will bring out the fact that the ionic concentration of the salt plays a great part in its rate of absorption, that is, as the concentration of a salt goes up the quantity of solvent absorbed per unit time, goes down. Thus the 0.5 per cent sodium bicarbonate solution shows a far greater absorptiveness than the 1 per cent (about two times as good), while the 2 per cent is definitely hygroscopic.

As is indicated elsewhere, the bicarbonate solutions were run in combination with the glucose in varying concentrations. In all instances the addition of the former slowed up the rate of absorption of the latter.

The commercial water was used in this series of experiments because of its reputation as an alkalinizer and due to its use by a few surgeons as a proctoclyster. Those who had

TABLE XII—SODIUM BICARBONATE SOLUTIONS

	cm.
1/2 Per cent sodium bicarbonate	100
1/4 Per cent sodium bicarbonate	50
1/8 Per cent sodium bicarbonate	25
Total 1/2 per cent sodium bicarbonate 100 cc. m.	175

TABLE XIV—GLUCOSE AND SODIUM BICARBONATE SOLUTIONS

	cm.
1/2 Per cent glucose and 1/4 per cent sodium bicarbonate	100
1/4 Per cent glucose and 1/8 per cent sodium bicarbonate	50
1/8 Per cent glucose and 1/16 per cent sodium bicarbonate	25
Total 1/2 per cent glucose and 1/4 per cent sodium bicarbonate 100 cc. m.	175

TABLE XIII—TAP WATER AND NORMAL SALT SOLUTION

	cm.
1/2 Per cent sodium chloride	100
1/4 Per cent sodium chloride	50
1/8 Per cent sodium chloride	25
Total 1/2 per cent sodium chloride 100 cc. m.	175

TABLE XV—TAP WATER AND SODIUM BICARBONATE SOLUTIONS

	cm.
1/2 Per cent sodium bicarbonate	100
1/4 Per cent sodium bicarbonate	50
1/8 Per cent sodium bicarbonate	25
Total 1/2 per cent sodium bicarbonate 100 cc. m.	175

it necessary to use a suspension rather than a solution

Glucose solutions Clinically it has been noted that the patient empties his bowel occasionally when submitted to a glucose proctoclyster over a period of some time. This phenomenon has been ascribed to the fact that the solution becomes irritating. The proper interpretation is hard to determine but presumably a mass reflex is initiated which causes an emptying movement. This is usually in regard to the 5 per cent solution. We have noted that these solutions are definitely hygroscopic. It would seem then that under the present method of clysis (the drip method) there would be a constant piling up of the fluid pressure within the bowel with additional fluid coming into the latter from the blood. The bowel is in this fashion prevented from diluting the glucose to the point where it is readily absorbed and the resultant distention of the gut causes a mass peristalsis. There is little doubt that the higher concentrations are irritating for we have noted repeatedly that the fluid returned from the bowel in both dogs and human is clouded with mucus. It will be noted further that as the concentration of glucose goes up the rate of absorption of both solvent and solute goes down. This is especially noticeable in studying the 1 per cent and 5 per cent solutions. The 0.5 per cent glucose however has less water and less dextrose absorbed from it than the 1 per cent so it appears that

we are dealing with a slope to and from the latter. This makes it evident in any circumstance that the theoretical concentration for an optimum solution (5.2 to 5.4 per cent—Fantus) is far too high.

We are puzzled by the fact that some of the solutions showed a higher sugar concentration at the end of a run than at the beginning. This seems to be independent of the concentration and of the order in which the solutions were run. It is not a hangover from the previously run solution because it appeared as well in the first experimental run on days—when the previously run distilled water showed no dextrose content. Distilled water was run as the first solution in 9 out of 10 experiments to determine whether there were reducing substances in the bowel—and though the water was returned distinctly yellow in several cases due to the fecal material we were never able to get a positive test for sugar. The latter tests were run on the sixth series. Two experiments were controlled in the same fashion in the fourth series with the same results.

All sugar determinations were made by the Folin Wu colorimetric method. The 0.5 per cent, 1 per cent and 5 per cent glucose solutions were not made up to the exact concentrations by analysis because it was felt that slight variations in the concentrations would lead us to a better knowledge of what actually occurred. These small variations had no apparent effect upon the results. The glucose

THE INCIDENCE OF TETANUS BACILLI IN THE STOOLS AND ON THE REGIONAL SKIN OF ONE HUNDRED URBAN HERNIOTOMY CASES¹

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POSTOPERATIVE tetanus has for many years constituted one of the most dreaded surgical complications. In spite of the recent advances in asepsis and operative technique, cases of tetanus following various surgical procedures are still occasionally encountered. Even the most rigorous precautions and meticulous attention to asepsis may be insufficient to prevent the unwelcome appearance of lockjaw. The experience from time to time of having a patient die following a relatively simple, elective operation, as for instance herniotomy, leads one to develop a dread of the tetanus bacillus. The sheer helplessness of the operator once lockjaw appears, leads him to consider even the advisability of routine administration of prophylactic doses of tetanus antitoxin. Obviously it is far more desirable to determine the source of infection and to eliminate it if possible. The present study was undertaken with this object primarily in view.

The great diversity of operations and the wide variation in incubation periods in connection with postoperative tetanus is well illustrated in a historical and statistical review of the subject. Wilms, 1868-1879, placed on record 5 cases of tetanus following herniotomy. Olshausen, 1886, collected 49 cases of tetanus following ovariectomy. Pizzini, 1898, isolated tetanus bacilli from the pus, faeces, and the appendix of a 25 year old individual who died of tetanus. Koch, 1898, related a case that had been operated upon for myoma of the uterus. The patient developed tetanus on the sixth day and died on the seventh. Tourneau, 1904, described three cases of tetanus, one of which followed herniotomy. The patient convalesced uneventfully until the ninth day when tetanus set in, causing death. Zaccharias, 1908, reported 2 cases of tetanus following gynecological opera-

tions. One of his patients recovered while the other died on the third day following the onset of tetanus. Richardson, 1909, published 2 of his own cases of postoperative tetanus. In the first case, 6 days after a gall-bladder operation, tetanus developed and caused death within 48 hours. In the second case, operation was performed for strangulation of omental tissue in the sac of a right inguinal hernia. The patient recovered and left the hospital after 14 days. A week later signs of tetanus appeared and the patient died 2 days later. The same author recorded 21 other postoperative cases of tetanus which were operated upon for the following cause or procedure: ovarian cyst, 4, hysterectomy, 4, radical cure of hernia, 4, gall stones, 3, acute appendicitis, 1, acute pancreatitis, 1, carcinoma of the rectum, 1, varicosities, 1, and scirrhus of the breast, 1. Eighteen of these 21 patients died.

Reinhard and Assini, 1909, described a case of tetanus which developed 10 days after a herniotomy and ended fatally within 3 days. Natonek, 1914, gave a complete review of the literature of various types and sources of tetanus infections. Speed reviewed the literature of postoperative tetanus up to 1916 and described 6 cases, 2 of which were observed in the Cook County Hospital, Chicago. His cases are as follows: 'In Case 1, hysterectomy, salpingo-oophorectomy, and appendectomy were done and 11 days after the operation evidence of tetanus appeared and resulted in death. In Case 2 an inguinal herniotomy was performed and secondary hæmorrhage followed. Tetanus developed 9 days after the operation and ended fatally. In Case 3, tetanus developed 15 days after a cholecystectomy and caused death. In Case 4, cholecystostomy with drainage was done and tetanus appeared 7 days later and led to

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intimate knowledge of its use were enthusiastic about it to the extent that they prescribed it for those patients that were unable to retain the classical clysters and stated that it was much better retained than those they were accustomed to use routinely. The results which we had with the solution were very favorable and may be explained on the basis of its salt concentration. It must be remembered that most of the calcium in this solution precipitates out at body temperature as the insoluble carbonate.

CONCLUSIONS

1. The role of proctoclysis is in the establishment and maintenance of water balance in selected cases where it is impossible or inadvisable to administer fluids by mouth. It is used rather than hypodermoclysis or intravenous infusion in any but acute conditions and in conjunction with those methods in the latter. It is our contention that such administration of fluid is thoroughly adequate and physiological.

2. One per cent glucose solution is the most efficient proctoclyster of those studied in this series. It may be combined with 0.5 per cent sodium bicarbonate with a somewhat lowered rate of absorption but a possible greater effect in combating acidosis.

3. Of the inorganic salts studied 0.5 per cent sodium bicarbonate solutions were superior to others in rate of absorption.

4. Isotonicity is not the ideal concentration for a given solution for by maintaining such a concentration we are neglecting one of the best properties of the gut—its action as a semi-permeable membrane. Hence if we introduce a solution definitely hypotonic to the blood it is more readily absorbed—following the laws of osmosis. In regard to the glucose solutions we may consider that the selective activity of the gut cells comes into play.

The writer is indebted to his most appreciative Dr. A. B. L. Khardt for the University of Chicago for his assistance and friendly criticism. With his help he composed. Since appreciation also extended to Dr. L. L. and S. W. McArthur who made the trial. The writer also wishes to thank Dr. E. V. Stiff, Dr. J. H. Sloan, Dr. E. Stipan and many others who have so kindly aided in this work.

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Tetanus bacilli are much more common in the stools of rural people who come in contact with soil, domestic animals, horses, cattle, etc., than in urban people. Ten Broeck and Bauer found about one-third of the population in the vicinity of Peiping harboring tetanus bacilli in the digestive tract. They claim that tetanus bacilli grow in the intestinal tract, for one individual may eliminate several million tetanus spores in a single stool. Buzello and Rahmel, in Germany, examined 50 rural cases (46 men and 4 women) for the presence of tetanus bacilli in the feces. These people were normally engaged on farms. Of these 50 individuals 20, or 40 per cent, showed tetanus bacilli in the stools without showing any symptoms of tetanus or ever having had the disease. The authors claim that a previous injection of tetanus antitoxin had no effect upon their findings. Kahn, in his investigation of anaerobic flora in 72 individuals in New York City, found none containing tetanus spores. He concludes that New York City lacks an adequate medium for such infection, whereas in China, where night soil is used for fertilizing purposes, tetanus bacilli and carriers of tetanus spores are much more widespread. Fildes examined feces from 200 persons in England and isolated tetanus bacilli from 2. Bauer and Meyer, in their study of human intestinal carriers of tetanus spores in California, found that 24.6 per cent gave positive results. Most of the individuals examined, however, were not natives of California, but their nationality is not given. Bauer and Meyer contend that tetanus is more prevalent in California than in Eastern United States and quote statistics of the State Board of Health of California which for the period of January 1, 1922, to December 1, 1925, include 245 cases of tetanus with a mortality of 67 per cent. Szymonowicz, 1929, agrees with other workers that carriers of tetanus bacilli are largely among rural people as well as among cavalrymen.

This study was undertaken in the hope of finding the percentage of carriers of tetanus bacilli in stools and on the regional skin of 100 herniotomy cases in Chicago and vicinity where, according to the literature, no such study has ever been made.

METHOD

The method of culturing adopted was that suggested by Dr. Ivan C. Hall in a personal interview. The inguinal region as well as the umbilicus were swabbed with a sterile cotton applicator, 1 per cent dextrose veal infusion broth being used. A specimen of feces was also collected. A small representative portion of the stool was thoroughly emulsified, cultured aerobically, and then each emulsified specimen was divided into two portions, one of which was heated at 80 degrees C for 20 minutes to kill the non-spore-bearing organisms. Cultures of the unheated as well as of the heated specimens of feces and skin washings were made in deep 0.1 per cent dextrose brain broth sealed with sterile vaseline. These heated and unheated cultures were made at Dr. Hall's suggestion because occasionally only vegetative tetanus bacilli are found which are killed upon heating at 80 degrees C for 20 minutes. The cultures were incubated for 7 days and Gram stains made at the end of 48 hours and after 7 days. Cultures showing Gram positive bacilli with terminal spores (tetanus-like bacilli) were subcultured by withdrawing 1 cubic centimeter of material from the bottom of the tube and making deep 0.1 per cent dextrose agar shake cultures. This was done with cultures which previously had been heated, while those which had not been heated before were heated at 80 degrees C for 20 minutes prior to making deep agar shake cultures. Aerobic plates were also made to test for the presence of aerobic organisms.

The deep agar shake cultures were made in tubes especially prepared for this work. They consisted of glass tubing about $\frac{3}{8}$ inch in diameter and about 8 inches long with rubber corks at the base and cotton plugs in the usual manner.

These cultures were observed daily for 7 days. Then the bottom of the tubes was gently warmed, the rubber stoppers withdrawn, and the column of agar permitted to drop into sterile petri dishes. The agar was cut into small pieces with a sterile scalpel and ten colonies were picked from each culture and inoculated into separate tubes of 0.1 per cent dextrose brain broth. After incubation for 5 to 7 days Gram stains were made and toxicity

death. In Case 5 the patient was dismissed from the hospital 12 days after a bilateral inguinal herniotomy but returned 6 days later with tetanus. A small pus pocket was found in the left inguinal region. Energetic treatment with tetanus antitoxin was instituted immediately and the patient recovered. In Case 6 a left sided inguinal hernia tetanus developed 11 days after the operation and ended fatally. The autopsy revealed one deep suture which had passed through the wall of the sigmoid. Smears and cultures of the exudate showed tetanus bacilli. Tulloch 1919 recorded 2 cases of tetanus which developed following abdominal operations: 1 an appendectomy and the other the reduction of an intussusception. Huggin 1920 cited a fatal case of tetanus which developed 8 days after a hysterectomy. In spite of vigorous treatment with tetanus antitoxin the patient expired within 48 hours. Murstad 1921 reported 4 cases of postoperative tetanus: 2 supravaginal hysterectomies, 1 appendectomy and 1 nephrectomy. Wohlgemuth 1923 observed 2 cases of postoperative tetanus each supervening upon resection of the small intestine. Evidence of tetanus appeared on the fifth and tenth days following operation.

Records of cases of postoperative tetanus indicate that the largest number develop subsequent to lower abdominal operations especially in the rectal, genital and pelvic regions. This observation has led to the incrimination of the intestinal tract as a source of infection. Matas as early as 1910 pointed out that infection occurred through the faeces and therefore he advised abstinence from raw fruits and vegetables as well as thorough cleansing of the intestinal tract 3 to 4 days prior to operation. In 2 cases of postoperative tetanus which he observed the patients partook freely of uncooked vegetables 24 to 30 hours prior to operation. Huggins agreed that the intestinal tract was the source of infection and advised in addition to abstinence from raw fruits and vegetables the administration of a stooge purge preliminary to operation. Tulloch also substantiated the contention of Matas that the intestinal tract is the source of infection in tetanus following abdominal operations. In one of his cases of tetanus following an appen-

dectomy tetanus bacilli were isolated from the wound in the abdominal wall from the stump of the appendix and from the faeces in the descending colon.

That the intestinal tract may be the source of contamination of abdominal wounds is indicated by the incidence of tetanus bacilli in the intestinal tract wounds and lesions developing between the digestive tract and the abdominal wall. Pizzini isolated tetanus bacilli from the faeces, pus and appendix of a 25 year old individual who died of tetanus. This author claimed that the infection had taken place through the intestine. Reinhard and Assini in their fatal case following herniotomy isolated tetanus bacilli from the pus of the wound the day of onset of the lockjaw. Tetanus bacilli were subsequently recovered from the inguinal lymph glands, heart, blood, lungs, liver, spleen and kidneys. Speed isolated tetanus bacilli from the exudate of a deep suture which was passed through the wall of the sigmoid during an inguinal herniotomy. Tulloch described 2 cases of tetanus following abdominal operations in both of which the infection was intestinal in origin. In the first case that of an appendectomy tetanus bacilli were isolated from the wound in the abdominal wall, the stump of the appendix and the faeces in the descending colon. The organisms proved virulent for animals. In the second case in which an intussusception was reduced, material from the wound and faeces revealed tetanus bacilli. The same author during his extensive work on war wounds found that 20 per cent of wounds of men showing no clinical evidence of lockjaw contained tetanus bacilli at some time during the process of repair. He concluded that the degree of tissue devitalization is the determining factor in the growth of tetanus bacilli and that this devitalization may be produced by bacillus welchii toxin. According to him tetanus bacilli may be found long after the infection of the wound (832 days in 1 case). Van der Reis found almost a pure culture of tetanus bacilli in the lower ileum and caecum of a patient with secondary anaemia who suffered from neither tetanus or abdominal distress. These organisms were highly pathogenic to animals.

CONCLUSIONS

1 The stools of healthy individuals not infrequently contain tetanus organisms

2 A fair percentage of individuals harbor on the skin adequate tissue devitalizing organisms (bacillus welchii in combination with pathogenic aerobic bacteria) even after the usual routine surgical preparation

3 The occurrence of postoperative tetanus in cases in which exogenous sources (catgut, etc) can be excluded are to be traced to organisms derived from the intestinal tract

4 Stool and regional skin cultures should constitute part of the routine search for the source of contamination in all cases of postoperative tetanus

5 The incidence of healthy carriers of the bacillus tetanus is relatively high among the rural population and relatively low among urbanites (1 per cent in Chicago)

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CLINICAL SURGERY

FROM THE ROYAL HUNGARIAN UNIVERSITY

RADIUM TREATMENT OF CANCER OF THE CORPUS UTERI

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OPINION as to the value of radium in the treatment of cancer of the corpus uteri is as yet not uniform. According to the majority of workers, cancer of the corpus uteri, because of the organ's low grade sensibility to radiation, does not as a rule respond favorably to radium therapy. Other authors, however, report most gratifying results.

At the First Gynecologic Clinic of the University of Budapest between 1919 and 1920, 101 cases of cancer of the corpus uteri have been observed. Of these 45 were treated by means of radiation therapy, the other 56 by operation. With this large number of relatively carefully observed and followed up cases, we shall try to give an exhaustive discussion of this question.

Cancer of the body of the uterus is found less frequently than cancer of the cervix, it represents about 10 per cent of all cancers of the female genital organs. Most patients with cancers of the corpus uteri have passed the menopause. Cancer of the corpus uteri is most frequently encountered between the fifth and sixth decades, it is not a rarity, however, even in later decades. The age incidence in our cases is shown in Table I.

TABLE I—AGE INCIDENCE IN CANCER OF CORPUS UTERI

Age in years	Cases
20 to 30	0
30 to 40	5
40 to 50	29
50 to 60	40
60 to 70	23
70 to 80	4

The youngest patient in this series was 34 years, the oldest 75 years of age. In addition to the greater frequency at the more advanced age, there is another difference between cancer of the corpus and of the cervix in that the latter is relatively more prevalent in nulliparous women. In our series there were 38 nulliparæ, 2 of whom were virgins, 14 primiparæ, and 49 multiparæ.

The most important symptoms are irregular bleeding and a bloody, foul discharge. Irregular bleeding in older patients, especially after the menopause, should arouse the suspicion of the presence of cancer of the corpus uteri. Pain is a later symptom, as a rule it indicates the encroachment of the tumor upon the surrounding tissues. Diagnosis can be made by uterine scraping and microscopic examination of the tissue removed—enlargement and softer consistency of the uterus, bleeding, and discharge, which are generally observed, cannot be accepted as sufficient evidence of the presence of this disease, nor are uterine sound findings reliable diagnostic criteria.

On microscopic examination cancer of the corpus uteri usually has the appearance of adenocarcinoma, more seldom that of solid carcinoma. In our series there were 86 instances of adenocarcinoma, 13 instances of solid carcinoma, and 2 instances of carcinosarcoma. According to many contributors the prognosis in a given case depends to a certain extent on the histological character of the tissue. In general, it may be said that adenocarcinoma is more radioresistant than is solid cancer. When the cancer involves the corpus uteri, the prognosis is more favorable than when the growth involves any other part of the female genital tract, owing to the fact that the process remains for a relatively long time localized in the body of the uterus. The thick muscular wall of the uterus protects the parametrium and surrounding organs from encroachment, so that their involvement is a late complication. Remote metastases are rather unusual.

For cancer of the corpus uteri, there are two types of treatment, surgical removal and radiation treatment. As cancers of the corpus uteri are localized in character they offer a favorable field for surgical treatment. Several authors report as high as 80 per cent operability, whereas in cancer of the cervix the operability generally does

THE ETIOLOGY OF PLACENTA PRÆVIA

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ALTHOUGH placenta prævia is regarded as a very dangerous complication of pregnancy when sufficient care is taken the mortality should be practically nil. In the first 4 years of the present Maternity there were 78 cases with no death. In spite of the good results the condition is one to avoid when possible and anything which suggests a method of avoiding a repetition of the disease must be seized upon with avidity. We are carrying out clinical and experimental investigations the results of which we hope to publish in due course.

In a paper read before the British Medical Association in 1929 by one of us (BS) the known theories were mentioned and the remarks made. A pathological condition of the endometrium is a fruitful cause of placenta prævia. Curettage should be done before the next pregnancy. In the practice of the author there has never been a repeat case.

We must now reiterate that it is quite unreasonable to imagine that the ovum can indulge in a uterine abortion after which it is to acquire new life again. Theories other than these which suggest some pathological condition of the endometrium bear no close scrutiny.

From animal experiments conducted by one of us (HIC) and from observations on the non-pregnant uterus we believe that the cause of placenta prævia lies in a defective or deficient production of the decidua formation of the upper portion of the uterus with a normal or sufficient amount of decidua in the lower portion of the uterus. When the fertilized ovum therefore enters the uterus it will seek the place where it can obtain the greatest amount of nourishment. Since the upper portion is deficient or poorly developed to receive the tenant it will be attracted to the greatest amount of decidua reaction in the lower portion of the uterus.

The factors which predispose to deficient decidua formation are those which diminish the stroma of the endometrium thus replacing it by fibrous tissue e.g. infections frequent pregnancies. It is known that the amount of decidua reaction will depend upon the cellular structure of the endometrium; that is the more cellular the greater the production of the decidua. Changes in the endometrium as to diminution of the stroma cells occur more readily in the upper portion than in the lower. There is therefore no deficiency of stroma cells in the lower portion so that there should be a normal amount of decidua production when pregnancy occurs.

In a normal uterus the amount and thickness of the decidua is uniform and when a fertilized ovum enters the uterus it will implant itself immediately in the upper portion as there is no need to look for a better site. But when the upper portion is deficient then for physiological reasons that in order to continue its growth it must obtain better nourishment it will look for a better location.

If a rabbit's horn is traumatized (by passing a needle through) and allowed to become pregnant pregnancy in that horn is most unlikely to occur. If the upper portion only is traumatized and the lower one left is free and the rabbit is allowed to fall into pregnancy or pseudo pregnancy the greatest amount of angiogenesis will occur in the non-traumatized area. Thus we may conclude that by traumatizing the endometrium we destroy the stroma and probably in those parts fibrous tissue takes its place and the latter is a poor producer of decidua formation.

SUMMARY

A new theory for the causation of placenta prævia is suggested. It is entirely plausible as borne out by experiments on animals and clinical observations.

the neoplastic focus, we are unable to regulate the distance at which the radium tubes should be placed to give adequate irradiation. The latter circumstance is a great hindrance in those cases in which there are complications from uterine fibroids, which are found in about 25 per cent of the cases. In cancer of the corpus, a relatively small number of patients is inoperable because of the great extension of the process, advanced age, general debility, and concomitant diseases often contra-indicate surgical intervention. In inoperable cases radiation therapy is the only method of treatment.

In our series of 101 cases, 45, or 45.5 per cent, were inoperable. Patients unsuitable for operation were referred for combined radiation treatment. The intra-uterine application of radium is accomplished with the utmost care, great precautions are taken to prevent infection. Fortunately, in our series, no severe infections have been observed. During the course of treatment two patients had high fevers which subsided after the radium tubes were removed and the patients rested for a few days.

In the uterine cavity usually we apply 50 to 75 milligrams of radium, which is enclosed in silver or brass tubes of a thickness equivalent to a filter of 1 millimeter of platinum, and these tubes are placed in a sterilized capsule. If possible, the total dosage of 2,400 to 3,600 milligram hours is administered at one sitting. More recently we have completed the intra-uterine application by giving 2,000 to 2,400 milligram hours of radium through the vagina. For external irradiation the X-ray is employed, three times through from two to six portals of entry—three-fourths of a skin erythema dose per portal, which is equal to 470 r measured in air. The apparatus consists of a radiotransverter machine, Coolidge tube, 185 kilovolts, 5 milliamperes, $\frac{1}{2}$ millimeter zinc plus $\frac{1}{2}$ millimeter aluminum filter, 30 centimeter focal skin distance. Patients who have received ra-

diation therapy are re-examined at first every 6 weeks, later every 3 months, and then every 6 months, respectively. To those who do not appear for re-examination questionnaires are sent.

Of 45 patients with inoperable cancer of the uterine corpus treated by means of radiation therapy, 26 were under observation for more than 5 years. The duration of life after treatment is shown in Table II. One each was free from

TABLE II—DURATION OF LIFE AFTER TREATMENT

Years after treatment	Cases
Less than 1	9
1	5
2	7
3	1
4	0
5	1
6	1
7	1
8	1

recurrence for 6, 7, and 8 years, respectively, and these three are still under observation. There are therefore 4 cases of 5 year cures, 15.3 per cent. Of 19 cases observed for less than 5 years, there are free of recurrence 1 for 4 years, 2 for 3 years, 1 for 2 years, and 2 for less than 2 years.

In the medical literature, among others who have published the results which they have obtained in radiation therapy in rather large series of cases of cancer of the corpus uteri are Amreich, Bumm, Doederlein, Eymmer, Gal, Heyman, Lacasagne, Lehoczy-Semmelweis, Schmitz, Seitz, Voltz, Ward, Wintz, and Zweifel.

The problem of radiation therapy in cancer of the body of the uterus cannot be regarded as definitely solved. With added experience, however, we would seem to be justified in the hope that further development and improvement in radiation therapy will lead to results far superior to those so far obtained.

not exceed 25 per cent. Simple vaginal hysterectomy usually suffices. More extensive operations are seldom necessary. Laparotomy is done only in the presence of complications such as large fibroids or inflammatory tumors of the adnexa. The high operability percentage and the fact that less extensive operations are required so that the operative mortality rate is low explain the empiric fact that surgical treatment of cancer of the uterine corpus yields much better results both relative and absolute than those obtained in the surgical treatment of cancer of the cervix. Collective statistical data on cancer of the corpus uteri show about 50 per cent of surgical cures.

At the First Gynecologic Clinic of the University of Budapest of 201 cases of cancer of the corpus uteri observed during 10 years, 56 were operable, 56.5 per cent. Of the 28 cases observed for more than 5 years, 12 were cured, 42.9 per cent. There were 3 deaths, thus making the operative mortality rate 5.3 per cent. Owing to its high percentage of operability and to the favorable results in such treatment of cancer of the body of the uterus, surgical treatment is naturally preferred. In general only cases inoperable in the anatomical and clinical sense of the word are referred for radiation therapy. To the cases inoperable from an anatomical standpoint because of the widespread extension of the disease there must be added a great number which are clinically inoperable because of advanced age, poor general health or some other complication, all of which tend to make the patient a bad surgical risk.

In the radiation treatment of cancer of the corpus uteri we combine radium with the X-ray. Radium is used for local treatment, but for the parametrium and the lymph glands high voltage radiation is used. The latter is used also in the postoperative treatment. Before radium tubes are introduced the cervical canal must be dilated. When radium tubes are being placed in the uterine cavity the utmost care must be used—struments and other material must be sterilized—in order to avoid untoward complications, sometimes ascribed to radium therapy. Septic complications after the application of radium in the treatment of cancer of the corpus uteri as a rule result from forced dilatation of the cervical canal. In the carcinomatous tissue masses of virulent streptococci can be demonstrated so that even a most insignificant lac ation may give rise to a septic process. If the cancer is large and so situated as to make dilatation difficult it is better not to use force to produce dilatation, but for the present to insert the radium tube in

the vagina. Such an application of radium may cause the growth to disappear or at least the virulence of the bacteria to be reduced. After this preliminary preparation and after the vagina has been irrigated with a disinfectant the conditions are much more favorable for an attempt to dilate the cervical canal. Uterine sound examination furnishes orientation as to the shape and size of the uterine cavity. The cervical canal is carefully dilated by means of metal dilators. The cervical canal must be dilated to a diameter larger than that of the radium tube in order to secure during treatment sufficient drainage of the discharge, a rise in temperature during the intra-uterine application of radium is often due to retention of secretions. For the insertion of radium tubes into the uterine cavity usually curved rubber sheaths which are available in various lengths and which can be easily sterilized are employed.

The radium should not remain in the uterine cavity more than 48 hours. If fever or chills occur the radium tube must be removed at once. The required dosage can be given by applying the tubes for short periods at a time at intervals of a few days. The technique of radium irradiation in the treatment of uterine cancer has not undergone appreciable change except that the utmost care as to application and aseptism must be used. It is due to these efforts that in most cases the danger from the spread of infection can be eliminated. In order to complete intra-uterine radium irradiation it is preferable to combine it with the vaginal application of radium. In the treatment of the parametrium and the lymph glands external radiation is employed, usually the X-ray is used or in institutes which have larger quantities of radium at their disposal the external application of radium at a distance is used.

The results of radiation therapy in cancer of the corpus uteri may be shown chiefly by means of the collective statistics of Seitz and Heyman. Seitz reports 233 cases in which cure was effected by radiation treatment in 78 or 34 per cent. Heyman reports 271 cases, both operable and inoperable, and in these cures are reported in 91 or 47.5 per cent. Against these favorable results in operable cases—results which nearly equal the result of surgical treatment—we find the outlook for radiation therapy much less favorable in the inoperable cases. In cancer of the corpus uteri the results in radiation therapy are usually influenced by the local grade of malignancy, adenocarcinoma to radiation and by the fact that as it is difficult to be certain as to the exact location of

sensation in the rectum which was followed in a few months by the passage of a small amount of blood. She was constipated but did not take purgatives regularly. During the last 6 months she had lost 25 pounds. She had a good appetite and digestion and slept well. She had had no past illnesses of any importance except that 10 years ago her gall bladder had been removed and following this she developed a phlebitis of the left lower extremity. A physical examination showed the patient to be in good condition. Pelvic examination showed a relaxed vaginal outlet with the uterus normal in size and position and no enlargement of the appendages. At the upper end of the vagina a mass, a little larger than a walnut, could be palpated in the rectum. The mass could be easily palpated with the index finger. The proctoscopic examination showed the mass to be ulcerating in character and a biopsy specimen proved it to be carcinoma. X-ray examination of chest and spine was negative. The Wassermann and Kahn tests were both negative. Blood pressure was 160-90, haemoglobin, 75 per cent, red blood cells, 3,500,000, white blood cells, 12,000, weight 124 pounds which was normal for her age and height. The urine contained albumin and many pus cells. She had previously consulted a colleague and friend of mine who had advised a two stage operation with the formation of a permanent colostomy. She had come in intimate contact with a friend of hers who had had a similar operation and stated that she preferred death to a permanent colostomy. She insisted that I try and remove her cancer per vagina as I had previously carried out a vaginal hysterectomy on an acquaintance of hers for carcinoma of the body of the uterus. After the usual pre operative preparatory treatment the following operation was carried out. Spinal anaesthesia with novocain was used and the patient was placed in the exaggerated lithotomy position. The sphincter was thoroughly dilated,

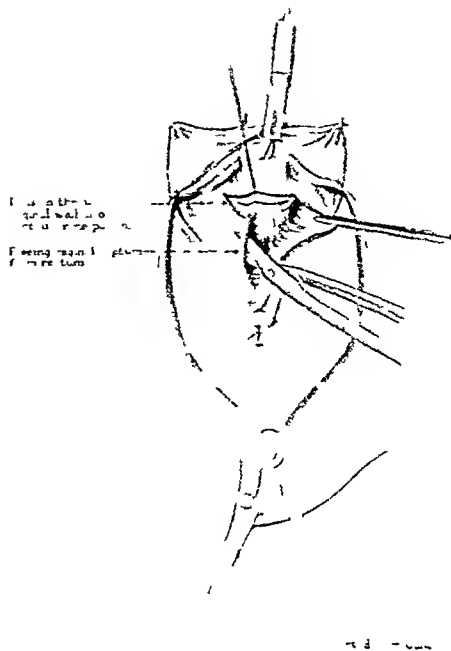


Fig 1

Fig 1 A semicircular incision was made behind the cervix, the peritoneum opened, and a suture passed through it for further identification. The pelvis was then explored by inspection and palpation and gauze packs were placed above the hymen to keep the small intestines from getting into the operative field. An incision was then made from the center of the semicircular incision down to within $\frac{1}{2}$ inch of the anus. This incision was carried down to the rectum with care not to lacerate it. (Adapted from Gant.)

Fig 2 The superior hemorrhoidal artery was ligated and divided between double ligatures and the gut divided with cautery between clamps. With the main source of the blood supply ligated and the peritoneum open it was quite easy to detach the upper end of the rectum from the sacrum with the finger, working first in one direction then in another. The mesorectal and lateral ligaments were incised and the rectum separated from vagina by dissection with scissors.

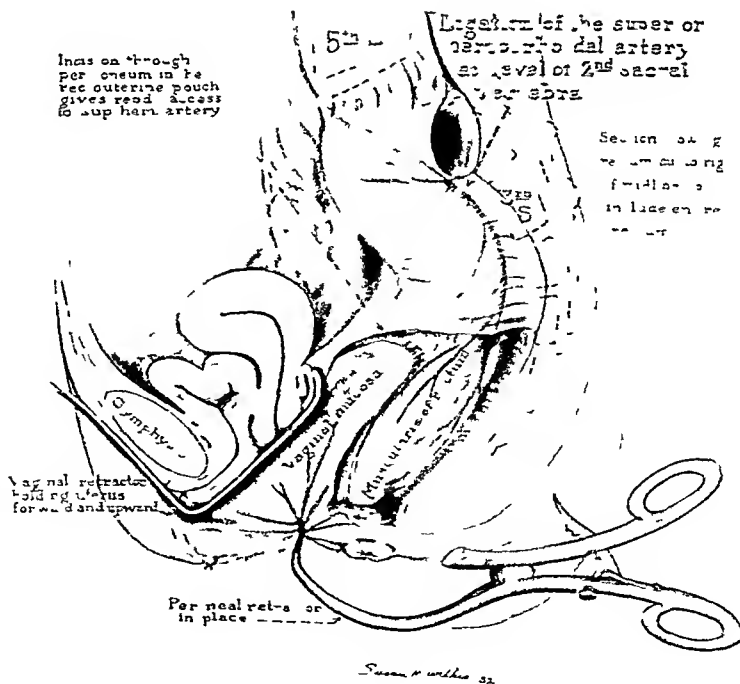


Fig 2

FROM THE VANDERBILT UNIVERSITY SCHOOL OF MEDICINE

AN EASY OPERATION FOR THE REMOVAL OF CANCER OF THE RECTUM IN THE FEMALE¹

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THE object of this communication is to call attention to an operation for the removal of cancer of the rectum in the female. The operation was first performed in 1890. In 1900 John B. Murphy read a paper before the Southern Surgical and Gynecological Association at its meeting in Atlanta entitled "Resection of the Rectum per Tag." This paper was published in the *Philadelphia Medical Journal* of February, 1901. Murphy did not remove the whole rectum as is carried out in the modern operation. He resected it and brought the two ends of gut together in an anastomosis interrupted silk sutures which were brought out through the anus. In nearly every one of his cases recto-anal fistula followed and was repaired at a subsequent operation. Murphy reported cases without a death and reviewed the literature up to that time. His paper gave the impetus which in time effected the modern operation.

It is of interest to note that cancer is still on the increase among civilized nations but rare in tribal communities. Gant says that he has never observed a case of cancer of the rectum in the American negro although he has maintained several clinics for this race. His explanation of this immunity is that tuberculosis and syphilis are prevalent in this race and that these diseases render them immune. This can not however explain the infrequency of carcinoma of the rectum in the American negro as all of them have not syphilis or tuberculosis. Williams table shows in 732 cases of organic cancer that the rectum was involved in females in 4.3 per cent and in males in 3 per cent of the cases. Nothmann in 343 autopsies specimens of intestinal carcinoma reports that 164 involved the colon and 16 the rectum. Gant's statistics show that the frequency of involvement of the various parts of the rectum in the 300 cases are as follows: rectosigmoid 13 per cent upper rectum 10 per cent ampulla 10 per cent anal 10 per cent total 43 per cent. Theology sinks with it is of importance and interest to remember that benign tumors of the rectum are potentially dangerous and in the majority of instances are

transformed into malignant growths in the course of time. F. W. Rankin (6) has recently published a paper which strongly emphasizes this point and shows concrete examples of neoplasms innocent in character being transformed into carcinoma. The symptoms I will not attempt to review as they are well known. The diagnosis is easily made if one will only make a rectal examination in every case that presents anal or rectal symptoms. It is a reflection on the surgeons of this country that cancers of the rectum in many instances are first operated on for hemorrhoids and the cancer is not discovered until another examination is made subsequent to the hemorrhoidectomy and to the persistence of symptoms.

I emphasize to the senior students that in my course in gynecology that an medical man in any city or hamlet regardless of his training can make a diagnosis of cancer of the cervix, rectum by a simple vaginal or rectal examination and prove it by biopsy should these examinations show anything of a suspicious nature.

I am firmly convinced that new methods of less stage rectal symptoms should call for digital or proctoscopic examination and that biopsy should be done if occasion demand it. The operation that I am about to describe is applicable only to cancers of the rectum females. It is ideal because the growth is in the lower rectum or sigmoid and in the posterior part of the rectum provided it is not too far advanced and some disease its use in cancer of the rectosigmoid. With this latter view I am in accord and would advise in rectosigmoid cancers following the method advised by J. Nes. Lahey Rankin (7) or Carey all of whom have read before this Society papers which are landmarks in surgery of the large intestine.

The following case is a rather typical example of this condition and will illustrate the procedure to my advantage.

Mrs. A. T. W., aged 59 years, widow married 9 years, 5 children, 7 children, the youngest 15 years, she also had a premature child. The family history was of no importance. She had been consulted in the past but had not been treated.

The operation provides abundant room and does not weaken the pelvic support. The superior hæmorrhoidal vessels with the peritoneum open can be easily visualized and ligated. Removal of the sacral glands and the division of the lateral and mesorectal ligaments is possible when the gut is being mobilized and the danger of injury to the ureters is avoided. Thorough drainage of all parts of the wound is possible. The operation can be carried out by any surgeon who has had proper general and gynecological training and experience. Spinal anæsthesia was used in this case, and at that time I was most enthusiastic about its use, but time, experience, and laboratory experiments have proved to my mind that it is a dangerous procedure and should be used only in selected cases and when other safer methods are contraindicated. My reason for this view is that during spinal anæsthesia a vasoconstrictor paralysis occurs. Vasoconstriction is the natural compensating device which nature employs as a corrective for the diminished volume of blood following hæmorrhage and for the low blood pressure sub-

sequent to neurogenic or reflex shock. A mild hæmorrhage may prove fatal if the patient is under spinal anæsthesia.

Gant has a special corrugated tube that screws into a rubber fæcal reservoir that is possibly of some convenience during the period when union of the severed gut is taking place with the anal margin.

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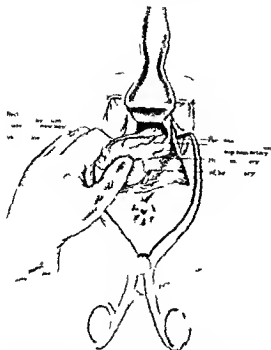


Fig 3. O. g. t. l. d. by. t. bly. plac. d. p. l. th. mudd. harm. h. d. l. s. l. e. l. g. t. e. d. d. th. gut. s. f. d. f. m. th. l. at. n. d. n. t. th. Th. rectum. t. th. a. l. canal. was. th. l. g. at. d. t. p. t. leak. p. cis. d. th. t. ry. d. b. l. f. th. t. um. wh. h. w. d. ta. h. d. l. f. t. th. g. h. th. g. l. ne.

th. ct. m. w. p. k. d. w. th. g. u. z. e. d. th. g. d. t. m. l. s. n. c. L. p. a. f. d. p. l. g. t. w. scrub. d. s. th. so. p. t. l. b. l. p. m. t. d. l. g. t. p. m. ac. d. l. c. d. th. s. f. d. th. t. g. a. t. Th. ix. d. p. p. g. e. th. u. gh. ly. x. p. o. s. e. d. th. r. y. z. d. w. th. h. o. o. k. d. p. u. l. l. e. d. f. r. w. d. A. s. e. m. u. l. m. p. d. d. t. p. s. e. d. th. h. t. f. f. th. d. t. Th. p. l. w. th. p. l. d. by. p. e. e. t. d. p. l. p. t. d. g. w. th. p. l. d. bo. th. b. m. t. k. p. th. m. b. t. e. s. f. m. g. t. g. t. th. f. t. f. l. d. l. w. th. m. a. d. f. m. th. t. f. t. m. r. l. a. d. t. th. h. f. th. Th. as. e. d. d. n. t. th. t. m. b. e. g. s. e. d. t. t. b. t. h. l. t. Th. p. h. a. m. r. h. d. a. l. t. r. y. l. g. t. e. d. d. d. d. e. i. b. e. n. l. b. l. g. t. l. th. g. u. t. d. d. e. d. t. e. r. y. b. e. t. w. l. a. m. p. W. th. th. m. in. so. f. th. l. l. o. o. d. p. p. ly. l. g. t. e. d. d. th. p. to. m. p. t. a. s. q. u. i. t. a. y. t. d. t. h. th. p. p. i. f. f. t. e. c. t. m. f. r. o. m. th. s. a. r. u. m. t. d. t. h. f. i. n. g. l. i. n. g. f. i. r. s. t. d. e. c. t. th. Th. m. so. t. a. l. d. t. l. l. m. t. s. e. d. d. th. r. e. c. t. m. th. s. e. p. t. d. f. i. m. th. g. a. by. d. i. s. s. e. c. t. n. th. s. c. i. s. s. o. s. O. o. g. w. t. r. o. l. l. e. d. by. t. bly. p. l. d. p. l. th. m. i. d. d. l. l. a. m. h. d. a. l. e. s. l. w. l. t. e. d. n. d. th. g. u. t. a. s. f. e. d. f. m. th. l. t. n. d. w. a. t. the. u. s. Th. e. c. t. m. t. h. a. n. a. l. c. a. l. w. th. l. g. a. t. d. t. p. t. l. a. k. g. i. d. w. th. c. a. t. r. y. d. th. w. l. f.

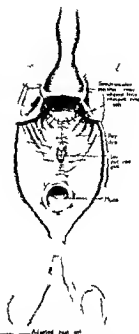


Fig 4. Sh. th. a. g. m. d. t. d. t. th. from. h. h. th. m. u. m. b. h. b. m. e. d. l. l. th. m. l. d. l. g. i. d. l. p. e. c. t. i. o. n. t. f. p. to. a. d. m. a. n. d. l. t. t. e. d. t. g. u. t. (A. d. t. d. f. m. G. u. t.)

th. e. c. t. u. w. h. h. w. d. t. h. d. w. a. s. l. d. e. d. t. th. g. h. th. g. l. T. l. m. m. m. l. f. th. a. n. a. l. a. n. a. l. f. b. g. l. s. e. d. th. p. m. d. a. l. t. u. o. a. s. d. t. d. t. d. m. d. Th. l. m. p. the. l. e. n. d. f. th. g. r. o. u. n. d. w. th. m. o. d. r. u. g. a. t. e. d. t. b. e. a. s. p. l. c. d. t. l. u. m. d. h. l. d. th. by. i. l. l. i. g. t. u. r. l. t. and. th. b. r. o. g. h. t. d. w. p. e. d. th. g. h. t. t. e. s. A. t. e. d. t. a. n. l. g. a. th. t. r. u. t. e. d. t. e. s. A. d. n. b. t. l. a. t. y. p. l. e. d. th. p. e. t. l. c. a. t. y. d. th. p. t. m. w. l. d. by. t. n. t. to. the. g. u. t. At. th. l. d. f. i. h. w. a. n. l. s. e. l. t. r. u. p. t. d. u. r. e. s. of. l. g. u. t. c. a. d. t. h. h. t. h. e. l. t. f. d. th. w. l. l. f. the. g. u. t. b. e. i. g. g. r. a. s. p. e. d. f. i. r. s. t. d. th. l. t. f. th. p. p. o. t. d. d. t. u. d. A. n. th. t. b. e. f. d. m. g. p. l. d. b. l. w. th. p. e. r. t. l. s. e. c. t. a. n. d. th. g. n. a. l. c. i. s. a. s. l. s. e. d. B. th. d. a. n. g. t. b. e. b. g. h. t. t. th. g. h. t. g. l. t. h. s. e. a. l. t. h. g. l. c. a. t. h. b. e. s. s. y. n. d. r. o. m. t. a. n. d. t. u. s. f. b. r. i. n. g. g. th. t. b. t. u. b. e. s. t. h. g. h. t. a. b. d. Th. p. l. t. r. y. w. f. f. c. o. m. p. l. t. t. o. l. f. h. e. p. h. t. t. h. r. o. g. h. u. t. h. h. p. e. r. f. t. t. o. l. f. h. e. p. h. t. m. s. e. l. d. w. t. h. d. f. g. m. th. a. t. h. s. n. o. g. n. f. l. o. a. l. r. r. d. t. i. n. t. t. a. s. e. s.

ADVANTAGES OF OPERATION

The operation described has the following advantages: the function of the splenic ter and the sigmoid and a permanent colostomy is avoided.

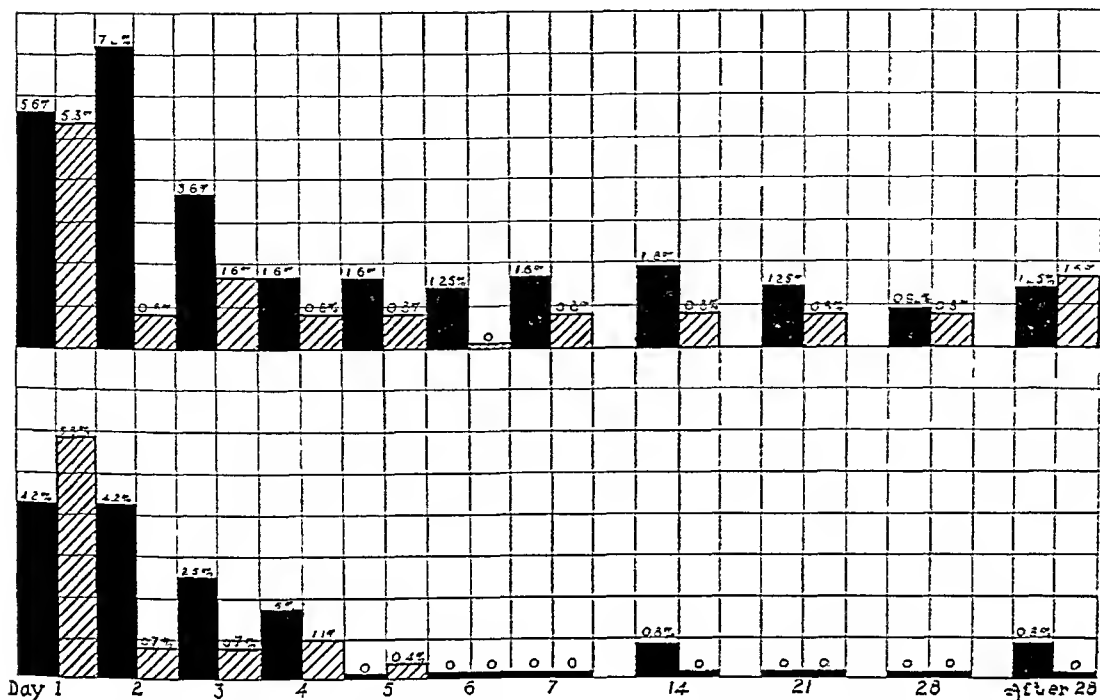


Fig 1 Graph showing percentage mortality by days in author's series (lower figures) and in series of Beekman (upper figures). The areas with diagonal lines indicate tannic acid treatment, the black areas other methods. The vertical lines indicate days after burn.

More important, perhaps, than the gross mortality rates, is an analysis of the deaths in relation to the various stages of the burn. The accompanying graph shows the percentage mortality by days in the author's series, and those obtained by Beekman, at Bellevue Hospital, before and after the use of tannic acid.

It will be noted that during the first 24 hours the mortality rate is much the same regardless of the type of treatment used. The deaths which occur during this stage are due to enormous burns which overwhelm the patient within a few hours. In our series, the patients in this group suffered burns involving anywhere from 50 to 90 per cent of the body surface. In other words, we are completely helpless to save patients of this group with any method of treatment so far devised, and probably will continue to be until the true nature of the death-dealing toxic process is discovered. During the second 24 hour period, however, there is a marked reduction of mortality in the tannic acid treated cases. Here we feel the tannic acid method saves the lives of a certain number of patients who are on the border line and would have been lost under older methods of treatment. There is also a marked reduction in later deaths

under the tannic acid regimen. Most of these deaths under older methods of treatment were attributable to infection and septic complications. That these complications are relatively rare with tannic acid treatment, all observers agree, and in our series there was not a single death from infection or septic complication. The 2.3 per cent mortality rate in our series subsequent to the first 48 hours, included 6 deaths in all. Two of these were late toxic deaths, occurring on the third day. The 4 remaining were cardiac deaths occurring on the fourth and fifth days. These will be discussed later.

Comfort of the patient. There can be little doubt in the mind of anyone who has worked with various methods of burn treatment, that tannic acid is comfortable for the patient. After the initial dose of morphine or codeine, which is administered when the patient is admitted to the hospital, frequently no further sedative is required for hours, and in some cases for days, if the tannic acid spray is promptly and efficiently applied. As soon as a firm coagulum has formed over the entire burned area, which usually takes place in from 12 to 24 hours, little attention need be directed to this area, for about a week. During

SIX YEARS OF TANNIC ACID TREATMENT OF BURNS

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Visiting Surgeon St. Luke's Hospital

EVALUATION OF THE RESULTS IN

THREE HUNDRED AND TWENTY-NINE CASES SO TREATED

SUFFICIENT time has elapsed since Dr. Harrison announced his early observations on the tannic acid treatment of burns in 1925 to justify a consideration of the results thus far obtained. The extensive literature already published on the subject testifies to the fact that the method is being used extensively throughout the world but it is difficult to find convincing statistics. Most of the observers are enthusiastic about the reduced mortality rates and the comfort of the patients when tannic acid is used.

Unfortunately burns do not lend themselves well to accurate statistical observations. The extremely variable factors such as the types of patients received by different hospitals, the marked variation from year to year in the number and character of burns in any given institution and the difficulty in describing satisfactorily the depth and extent of a given burn all tend to vitiate the value of small groups of statistics. It is only by pooling the results from large groups that any reliable estimate can be made but such figures are not now available. In the meantime we must use what criteria we can find.

The group of cases which is the basis of this report with a very few exceptions, as a criterion for the author's service and in all cases the general procedure for tannic acid treatment adopted by the burn service of St. Luke's Hospital was followed. The 310 consecutive cases included in the report were treated during the 6 years from 1926 to 1931 inclusive. For comparison with this series all the burn cases treated by various methods at St. Luke's Hospital from 1922 to 1931 inclusive were reviewed. More than half of the patients in this group comprising 121 cases were under the care or observation of the author. This fact is mentioned because we feel that it is difficult to evaluate the observations of others.

Effect upon mortality statistics. We have adopted as the criteria of the effectiveness of any method of burn treatment the following: (1) Does it save lives? (2) Is it comfortable to the patient? (3) Does it minimize complications and sequelae? (4) Does it favor healing? (5) Is it practical and economical?

In answer to the first question we may say that what statistics are at present available show a

marked reduction in mortality from burns when tannic acid treatment is followed. Harris of Toronto reports a reduction from 6.6 per cent mortality by other methods to 12 per cent by the tannic acid method. Herzfeld of Edinburgh and Wilson report a reduction from 38 per cent to 9 or 9.5 per cent. Beckman of New York City found a reduction in mortality from 27.8 per cent to 14.9 per cent and Bancroft and Rogers from 40 to 50 per cent to approximately 20 per cent. In the series reported by the author 221 burns treated by various methods gave a mortality of 14 per cent while in 310 cases treated by the tannic acid method the mortality was 9.6 per cent. From these figures it would appear then that under the tannic acid regimen the mortality of burns has been reduced from one half to one third. The very high mortality figures of 40 per cent to 50 per cent seem unreasonable for any type of treatment and are probably not representative. The author's figures seem a little low both for other methods and tannic acid but this is partly accounted for by the fact that our series was a mixed group of adults and children of all ages (less than 50 per cent were children) while most of the other reported groups were made up almost entirely of children.

The criticism may be made that these apparent improvements in mortality statistics are due to factors in the care of burned patients other than the tannic acid. It must be admitted that when a group of cases is being studied the mortality is likely to drop as a result of the greater care in detailed treatment accorded the patients under study. In our series we feel that the treatment other than the use of tannic acid was much the same in both series with some slight improvement in general therapy during the past decade.

Figures appear to indicate that in the same hospital series.									
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Use in first aid The criticism is sometimes offered that tannic acid is not practical for first aid in the home or in industry. It is true that there is no preparation of tannic acid which is as convenient to keep or apply at home as are some of the ointments and oils that have been used extensively. If the toxic theory of burns is correct the early treatment is very important. If ointments or oils are applied to the burn in the home or factory before transporting the patient to the hospital, much valuable time is lost in removing these materials with a fat solvent before tannic acid solution can be effectively applied. The tannic acid spray under an improvised lighted canopy can be carried on in the home, but not as satisfactorily as in a hospital. It is becoming generally understood both by the profession and the public that severe burns get along better with hospital care. Tannic acid compresses, re-enforced with a generous layer of absorbent cotton bandaged on, can be applied satisfactorily in the home or factory, will keep the patient comfortable and give him the benefit of the coagulating effect of tannic acid at the earliest possible moment. Tannic acid solution cannot be kept on hand, because it changes to gallic acid during a few days' exposure to light and air, becoming darker in color, and after this it should not be used. The dry powder can be kept indefinitely, however, and to make up a solution of an approximate strength is the work of but a few seconds.

Tannic acid jelly For 4 years, we have been working with a 5 per cent tannic acid jelly, made up with a tragacanth base about the consistency of the ordinary lubricant jelly, for use in first aid and on ambulatory burn cases. Tannic acid ointment made up with petrolatum or lanolin base is not satisfactory, because not enough of the tannic acid actually reaches the burned surface, and the oily base prevents air from drying the coagulum. The tannic acid jelly has worked fairly satisfactorily, particularly in industrial dispensaries, but has some disadvantages which we have not been able to overcome entirely. The jelly forms a hard coagulum almost as quickly as the tannic acid spray.

Summary Three hundred and ten consecutive burn cases treated by the tannic acid method are reported, with a mortality of 9.6 per cent. One hundred and twenty-one treated by various methods prior to 1926 gave a mortality of 14 per cent.

The tannic acid method is comfortable to the patient and with it the incidence of complications is low.

It has no essentially beneficial effect on epithelization.

The method is practical and economical.

THE MANAGEMENT OF BURNS WITH TANNIC ACID

The following general outline of treatment is the one we now follow on the burn service of St. Luke's Hospital. The method as originally described by Davidson has been considerably modified, in accordance with our experience. For many details in the management we are indebted to other observers in the field, as well as to the residents and internes on the service whose observations have led to helpful changes in the technique.

Immediate treatment important Instructions are posted in the accident room of the hospital detailing the treatment of burns. The precedent has been established that burns are to be regarded as emergencies and are to be treated without any delay. In severe burns, we believe that every hour of delay before tannic acid treatment is begun endangers the life of the patient. Experience has led us to believe that the toxic products of the burned tissue absorbed within the first few hours after the burn may determine the outcome. It is, of course, unnecessary to treat all burns as emergencies, but the fallibility of judgment in what constitutes a burn of dangerous degree is so great that, unless all burns are treated in this manner, a serious burn will occasionally be neglected. Even with a fairly large experience with burns, we find it quite impossible to estimate with any degree of accuracy at the outset the extent and depth of a burn. All too frequently a burn in a child is treated by means of some ointment in the home by a physician who regards it as a trivial affair until the second day when the child begins to vomit and have convulsions. The child is then rushed to the hospital at a time when effective treatment may be too late to avoid a fatal issue. These factors have led us to urge the family physician and the interne to regard all burns as serious until proved to the contrary and to give to each patient the benefit of prompt and efficient treatment. We make very little effort to classify burns according to degree or to calculate the area involved in percentages. Attempts to record burns in such manner are misleading and often inaccurate.

The patient is immediately put to bed, without any preliminary formalities in the accident room. He is given morphine by hypodermic, if suffering much pain, and is placed under a lighted cradle, with bedclothes over the cradle in which enough

this time the patient is relatively comfortable under his lighted cradle tent (sometimes named by the patient the covered wagon) with no cumbersome or painful dressings over the burned areas. Several patients under our care have suffered previous burns which were treated with other methods and all have been enthusiastic in their praise of tannic acid. No one who has spent tedious hours painful to the patient and exhausting to both the patient and the physician doing daily ambrine dressings will wish to return to such a regimen after a trial of the tannic acid method. To be sure there is some discomfort connected with the period of separation of the tannic acid coagulum which begins at the end of the first week. This part of the treatment need not be unduly painful if continuous dressings wet with Dakin's solution are used as described subsequently.

Incidence of complications. From the data obtained in our series as well as the experience of other observers it would seem that the incidence of septic complications of burns is much lower with the tannic acid treatment than with any other. As previously stated we had not a single fatal septic complication in our entire group of 310 cases (assuming our interpretation to be correct). In only one case did serious septic complications arise. This was an emaciated child of 3 years who suffered an extensive burn of both arms, chest, neck, and face and was treated for 2 days in a small outlying community before being transported some distance to this hospital. The child developed consecutively bilateral acute otitis media, bronchopneumonia, and a purulent hip joint infection but recovered.

We attribute the slight incidence of septic infections in our series to the early removal of the tannic acid coagulum with continuous dressings of Dakin's solution as soon as exudate begins to form under the coagulum. This deviation from the original technique of Davidson we consider very important and will be discussed in a subsequent section.

The data at hand concerning other complications are not convincing. In our series we encountered 3 cases of peptic ulcer (a clearly demonstrated by X-ray), 2 cases of acute cholangitis, 1 case of acute cystitis, 2 cases of acute polyarticular arthritis, 1 case of peripheral neuritis with paralysis of the common peroneal nerve, and 1 case of retinitis.

The 4 cases which we have classified as cardiac deaths deserve a little explanation. Three of the 4 were children. These deaths occurred on the fourth and fifth day; all had suffered severe burns

but seemed to be well over the dangerous toxic period with normal pulse rate and practically normal temperature when they suddenly went into collapse. The clinical picture was much the same in all the cases and reminded us very much of the late toxic cardiac deaths from diphtheria. In each case the symptoms came on suddenly when the patient appeared to be in excellent condition. The first indications were usually apathy, pallor, and a rising pulse rate followed by a brief interval of bradycardia, marked irregularity then vomiting, pulmonary edema, coma, and death. We have been unable to obtain electrocardiograms in any of these cases because of the sudden onset of symptoms and the rapidly fatal issue. The patients with severe burns upon whom electrocardiographic observations have been made showed nothing abnormal. We had not observed these phenomena which we have interpreted as being toxic cardiac effects before the days of tannic acid treatment and we have been inclined to conclude that the patients who develop late cardiac complications under the tannic acid method would not have lived long enough to show these changes under the older methods of treatment.

Effect on healing. In some of the earlier discussions on the tannic acid treatment of burns considerable enthusiasm was expressed concerning the rôle played by this method of treatment in the healing process and the opinion was voiced that epithelialization took place more rapidly under the tannic acid coagulum than with other types of treatment. It is doubtful if such enthusiasm is entirely justifiable in the light of subsequent experience. It is true that superficial burns in which the basal epithelial layer is not destroyed will be entirely healed when the coagulum separates spontaneously at the end of about 2 weeks, but it is equally true that burns of similar depth will be healed in an equal length of time by almost any other method. If the tannic acid treatment has any essential value in favoring healing it is because secondary infection is less likely to interfere with healing and this is of great advantage in the deeper burns.

Practical and economical. There can be little doubt that the tannic acid method is practical and economical. The materials required are inexpensive and easily obtainable and much less tedious care is demanded from nurses and hospital internes than with other types of treatment, which we are familiar with at least during the first week.

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body, as well as locally at the site of the burn, seems to be greatly increased. Along with this factor, the renal depression, which may be due to oedema of the tubules, renders the individual unable to excrete an unusually large volume of fluid. We have produced generalized oedema in several patients at this stage, with volumes of fluid slightly more than 100 cubic centimeters to a kilogram of body weight. This renal depression seems to last only about 3 days, and after that time the urinary output increases markedly. We have never seen a case of complete renal suppression which we were taught was a common occurrence in severe burns. Likewise, we have never observed any permanent renal damage that has resulted from a severe burn. Theoretically, the continuous intravenous infusion, popularized by Gallie and Harris, Horsley,¹ and others, should be ideal for use in severe burns, but after using it in a number of cases we have discarded the method, except for an occasional case. It is not difficult to produce generalized oedema by this method, in extensive burns. In one young adult, who seemed to be well over the toxic stage of the burn, but suddenly went into collapse and died a few hours after a continuous intravenous infusion had been discontinued, we felt that the amount of fluid administered intravenously had proved too serious a burden to an already handicapped myocardium. At the time the intravenous infusion was stopped, the patient had begun to develop generalized oedema. We have observed only one case of generalized oedema from fluids taken by mouth. This patient had received an extensive burn and demanded large quantities of water, even after he was apparently over the toxic stage. After taking between 6 and 7 liters of fluid per day for several days, he became oedematous. His intake was then limited to 4 liters, and after putting out enormous quantities of urine for several days he recovered his water balance.

Dakin's solution to remove crusts. After the initial temperature rise which usually takes place within the first 24 hours after the burn, the temperature drops to normal or only slightly above when the burned areas have become thoroughly tanned and remains at this level for 5 or 6 days. In the deeper burns, some evadate begins to form beneath the crusts between the sixth and eighth days, as evidenced by a rise in temperature, a sense of fluctuation beneath the crusts, malaise and sometimes delirium. It is at this point that we apply continuous Dakin's solution dressings to loosen up the coagulum as quickly as possible. Large rolls of gauze wet with Dakin's

solution are applied to the burned areas, after the normal skin is protected adequately with sterile petrolatum. A heavy layer of sterile absorbent cotton is bandaged over the gauze, and oiled silk is bandaged over all to prevent evaporation, the coagulated areas being kept moist at all times. These dressings are moistened every 4 hours with Dakin's solution, and the entire dressing is changed daily. This type of dressing is continued until the coagulum is all off and the granulating areas are clean and ready to graft or are healing rapidly with epithelial islands that were not destroyed by the burn. The initial application of moist dressings is usually accompanied by a sharp rise in temperature to 39 degrees or 40 degrees C, followed within 24 hours by a drop to between 38 degrees and 39 degrees, and a swinging temperature curve between this level and normal continues until the coagulum and necrotic tissue are all off. If the burn is a superficial one, the coagulum will be off within 3 or 4 days, however, in the deeper burn, where the skin is completely destroyed, it will be in the neighborhood of 2 weeks. It is important that the normal skin included in the dressing be adequately protected with petrolatum, otherwise the constant use of Dakin's solution will cause a painful dermatitis. When the coagulum is off, there remains a granulating wound with or without epithelial islands, and the use of a single layer of bandage gauze impregnated with sterile petrolatum between the granulations and the rolled gauze will render the dressings relatively painless.

The secondary toxic stage. A word of explanation concerning the moist dressings may be in order here, since the practice has been condemned by Davidson, Wilson, and others. In his earlier communications, Davidson insisted that the coagulum be left intact until it separated spontaneously, since upon the integrity of the coagulum depended the protection from toxic absorption. It was his assumption that the period of toxic absorption lasted for a week or more, and that if the coagulum was separated too early, the toxic symptoms would recur. In 2 of his early cases he attempted to separate the crusts prematurely with boric acid compresses, with disastrous results which he attributed to the early removal of the crusts. He had demonstrated the fact that during the first 48 hours following the burn, the blood urea nitrogen, urea nitrogen, and creatinine were elevated and returned to normal as the toxic symptoms abated. He observed that in the 2 cases mentioned, after the crusts were removed by moist compresses, toxic symptoms seemed to return while the nitrogenous products of the blood

¹Who credits the method to Matsas

lights are placed to maintain a temperature of approximately 85 degrees F. Any dressings which may have been applied are removed and if any grease or oil has been applied to the burned surface this is removed quickly and gently as possible with ether. Vesicles that have already formed are opened with sterile scissors and the outer layers of epithelium which are loose are peeled off. This is important because unless the badly damaged outer layers are removed the tannic acid will not coagulate the deeper layers. In the course of the first day if additional vesicles or bullae form they should be treated in the same manner. Gross dirt is removed from the wound but we have found thorough scrubbing with an antiseptic unnecessary and too productive of shock. We have never found it necessary to give the patient an anæsthetic to carry out the procedures just described. With care this process need not be very painful and the patient is spared the additional shock and blood concentration resulting from anæsthesia.

Stronger solutions of tannic acid. An aqueous solution of tannic acid (5 per cent for children and 10 per cent for adults) is sprayed over the entire burned area just as soon as the area is prepared (12). We are using the stronger concentrations of tannic acid (2 per cent) was the strength originally recommended by Davidson) because with the stronger solutions quicker tanning of the damaged tissues is obtained. The more rapidly this is accomplished the less the toxic absorption and dehydration. The spray from an ordinary atomizer is satisfactory. The tannic acid corrodes the metal parts of the atomizer however and usually one or two atomizers are used up in the treatment of each severe burn. Atomizers made entirely of rubber and glass are more satisfactory.

The tannic acid spray is not used on the face. We have experienced no difficulty from injury to the cornea with tannic acid but rather than risk possible injury to the eye we have avoided the use of the spray on the face. Instead we have been in the habit of using 5 per cent tannic acid jelly (tragacanth base). This can be spread over the face in a thin layer which as it dries leaves a firm coagulum over the burned areas. This jelly is also used occasionally in certain other inaccessible areas which are difficult to treat with the spray. Ictrolatum is smeared about the eyelids nostrils and lips to prevent them from becoming uncomfortably dry and stuff and also in burns of the perineum it is smeared about the external genitalia and anus.

The tannic acid solution is sprayed over the burned area every hour for the first 24 hours. In

very extensive burns we often pray the areas every 10 or 15 minutes during the first few hours in order to get the earliest possible coagulation. If the burned areas are well coagulated and dry at the end of 24 hours tannic acid spray may be omitted and no further treatment of the local site of injury will be necessary for several days. During this time of course the entire burned surface is left exposed to the air. When skin surfaces must come in contact (as between the arm and the chest all) a sterile towel is placed between the two. If any part of the burned area must come in contact with the bed a sterile sheet or sterile towels should be placed under the part. It is usually most satisfactory in large burns to have sterile sheets placed under the entire body.

Importance of combating dehydration. The most important feature of the constitutional treatment during the early stage of the burn is the administration of an adequate amount of fluid to combat the anhydremia. In an adult with a burn of moderate extent an adequate amount of fluid may be taken by mouth but if he is vomiting or has a very extensive burn it is usually wiser to give the necessary amount of fluid in the form of physiological salt solution or 5 per cent dextrose solution intravenously per rectum or by hyperdermoclysis. In severe burns we have been in the habit of giving one intramuscular or intravenous infusion of physiological salt solution and one of 5 per cent dextrose each day until the toxic manifestations are over. There has been considerable difference of opinion expressed concerning the amount of fluid that should be given the amount frequently recommended being 100 cubic centimeters a day per kilogram of body weight although some observers give larger quantities. According to the theories of Underhill and his associates blood concentration is the cause of most of the toxic symptoms of burns and the indications are for large quantities of fluid to combat this anhydremia. It is true that blood concentration takes place almost immediately after a severe burn and continues for a variable time. From clinical observations however it is difficult to accept blood concentration resulting from local changes at the site of the burn as the primary lethal factor. It seems more likely that the anhydremia is merely one of the manifestations of a profound toxemia the true nature of which has not yet been determined.

Too much fluid may cause edema. During the first 48 to 72 hours following the burn the patient is not able to handle as large an amount of fluid as was formerly believed. It is during this period that the permeability of capillaries throughout the

necessitating enucleation. The reconstruction of the conjunctival sac by means of grafted skin will be described in a later communication.

SUMMARY

A method of management of severe burns with tannic acid is described, the outstanding features of which are

Burns should be regarded as emergencies and treatment started at the earliest moment.

Burned areas are sprayed with a 5 or 10 per cent tannic acid solution, while the patient remains under a heated cradle.

An adequate amount of fluid is administered to combat dehydration, at the same time care is taken not to overload the circulation with fluid.

Continuous dressings wet with Dakin's solution are used to hasten separation of the coagulum during the "secondary toxic stage." The "secondary toxic stage" is described.

Early skin grafting is recommended to prevent development of a profound secondary anæmia, to diminish danger of late septic complications, and to prevent unnecessary scarring or contracture.

The treatment of chemical or electrical burns involves the same principles as do those caused by heat.

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again increased. He regarded these findings as indicating that the removal of the coagulum had released more of the toxic products which were present during the first 48 hours. We have not confirmed these observations concerning what we sometimes call the secondary toxic stage which comes on usually at the end of the first week following injury when the coagulum begins to separate. We have found no constant significant changes in blood chemistry determinations made during this stage, but our findings have agreed with those of Davidson during the first 48 hours.

From our interpretation of clinical data we would conclude that the true toxic stage of a burn is over within approximately 48 hours when efficient tannic acid treatment is started early. When tannic acid is started late or when other methods of treatment are used it seems probable that the true toxic stage lasts longer. What we have termed the secondary toxic stage coming on at the end of the first week resembles more the toxæmia of a mild acute infection or sepsæmia. It will be recalled that we have not had a single death during this stage in the tannic acid series (in fact no deaths after the fifth day) which would tend to confirm our impression that the secondary toxic stage is not a continuation of the initial toxic stage during which most of the deaths occur. It seems to us probable that the unfortunate results obtained by some observers may be attributed partly to the absorption of boric acid when the solution is used in large quantities to soften the coagulum and to its low bactericidal properties. Dakin's solution seems to control the symptoms of the secondary toxic stage admirably. In some cases in which it is necessary to continue Dakin's solution over a considerable period of time patients begin to complain of the burning sensation produced by the antiseptic solution. In such cases we often substitute physiological salt solution for a few days and always find that with the salt solution the elevation of temperature and symptoms are likely to recur only to disappear again when Dakin's solution is reapplied.

We feel that it is very important to do everything possible to hasten epithelialization of the granulating wound remaining after the tannic acid coagulum is off. During this stage a profound secondary anemia is likely to develop and if long continued the patient's ability to resist intercurrent infection is impaired. In general it is easier while to do some type of skin graft if the granulating wound is certain to take more than 3 weeks to epithelialize after all the coagulum is off and the granulating wound is clean. This is merely

a working rule and has its exceptions. During this stage we have found wet dressings of thioresol as described by Reimann alternating at intervals of 48 hours with physiological salt solution have a fairly definite tendency to stimulate growth of epithelium. In comparable cases in which Dakin's solution was used on one extremity and parathioresol on the other we have been impressed with the fact that the epithelium grew slightly faster over the areas treated with parathioresol. There are of course many indications for the use of transplants from the cosmetic and functional standpoint. These will be considered in a later report. Here we merely wish to emphasize the importance of skin grafting to promote early healing and prevent development of a profound secondary anemia and late septic complications.

Spec al types of burn. The problems involved in the treatment of chemical burns are essentially the same as those caused by heat. The first indication is for the immediate dilution of the acid or alkali with large quantities of fluid. The chemical is quickly fixed in the tissues and attempts at neutralization are unnecessary unless the burn is caused by a very concentrated acid or alkali. Flushing the burned area with large quantities of water or normal salt solution is usually adequate to dilute any excess of the chemical remaining. From this point on the burn may be treated with tannic acid and the course will be much the same as in the case of a superficial burn from heat.

Some deep burns from concentrated acids or alkalis are not affected by tannic acid since the superficial tissues are already coagulated by the chemical. This is equally true of small deep electrical burns. Since the coagulum is so thick the full thickness of the skin and sometimes underlying tissues it separates very slowly. In such cases much time in healing may be saved by doing an immediate excision and skin graft as advocated by Wells.

Serious burns of the eye are fortunately uncommon and are usually caused by chemicals. When they do occur the services of a competent ophthalmologist are required. It is astonishing how rarely the cornea is damaged in severe chemical burns of the face. The lid reflex apparently is quick enough to prevent damage to the eyeball in most cases. In chemical burns of the eye immediate flushing of the conjunctival sac with large quantities of sterile water or normal salt solution is important. Only one patient in our series suffered a serious burn of the eye. An alkaline drain compound was the causal agent and the conjunctiva was completely destroyed,

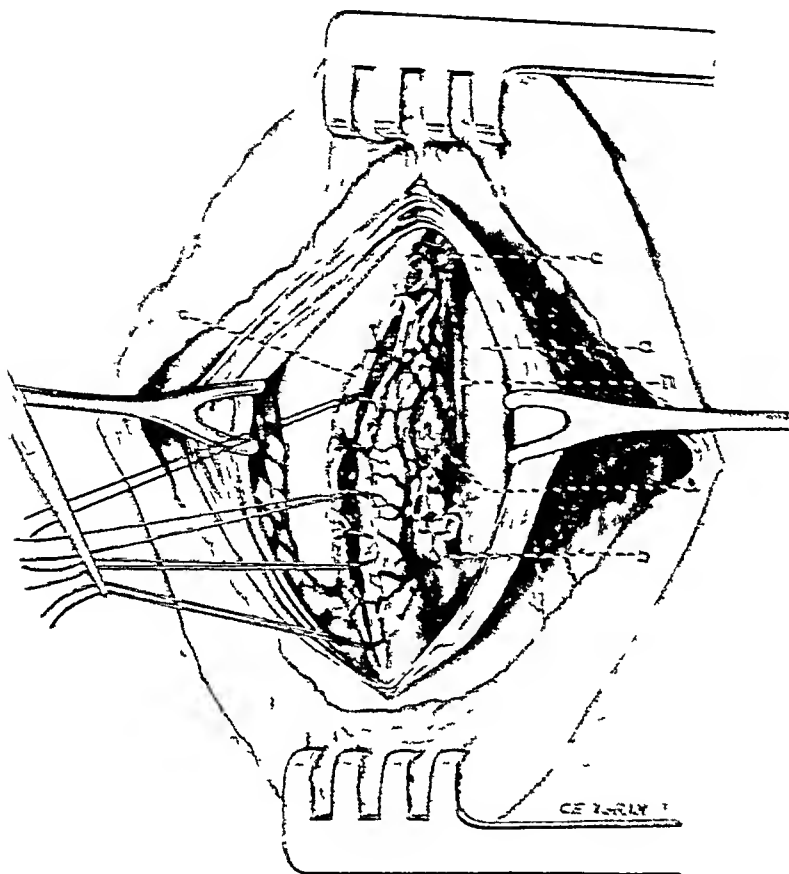


Fig. 1. The left lobe of the thyroid has been sub totally removed. The ligated upper pole. *a* Remaining goiter gland bed oversutured a few sutures left long retract the goiter bed mesially exposing parathyroid bodies *b* *c* Carotid and recurrent nerve *d*, Interior thyroid artery with a small branch leading into the interior parathyroid.

At one or two small parathyroids remain to maintain function. It seems that the experience gained in thyroid surgery will repeat itself on the parathyroid. At first surgeons were afraid to remove too much thyroid to avoid postoperative myxedema—first one-half then three-fifths was the limit, until we learned that it is better to remove too much than too little and the subtotal parathyroidectomy was accepted. As myxedema in surgery of the thyroid, so tetany is the bugbear of parathyroid surgery. In 18 cases of our own and of Oppel's (these, however, unilateral), and 15 cases from the literature, there was only one

fatality from postoperative tetany (Beck) and 3 not serious cases of postoperative tetany (Snapper, Barr and Bulger, Ballin and Morse). To be sure we realize that unfortunate complications like postoperative tetany are not always reported. Under proper precautions in technique and the after-treatment outlined tetany following parathyroidectomy is preventable.

In identifying the parathyroid bodies remember

First. There are usually four at the places mentioned but variations of site are frequent (Terry and Searls).

TECHNIQUE OF PARATHYROIDECTOMY

MAX BALLIN M.D. F.A.C.S. D.T. OFT. MICH. AN.

SINCE it has been shown that certain forms of osteomalacic conditions such as osteitis fibrosa cystica certain form of ankylosing arthritis and other conditions associated with an increase of the blood calcium are due to tumors adenomata or hyperplasias of the parathyroid glands and since parathyroidectomy in these conditions has given curative results there can be no doubt that the operation for removal of the parathyroids will be done frequently. Therefore an outline of its technique as we have applied it in 18 cases seemed indicated.

Preparation of patients is the same as for other operations on the neck. Some of the patients are very sick from painful deformities and should be properly protected against dehydration. There is no treatment for the hypercalcaemia before operation. The patient should be carefully transported to and placed on the operating table. It has happened that a decalcified bone fractured from improper handling. The stiffened dorsocervical kyphosis of the spine renders exposure of the neck some what difficult but obviously should not be forcibly overcome.

As an analgesic we prefer gas (analgas) combined with local 1 per cent novocain as an anesthetic. Some have used local anesthesia alone. At any rate the anesthesia should be light. Especially when operating around the recurrent laryngeal nerve it is wise to let the patient talk so that an intubation on the nerve is noticed by interference with phonation and respiration.

Incision: The usual collar incision as in goster suffices for parathyroidectomy. The straight parathyroid muscles of the neck are separated; the midline from the larynx to the sternal notch and extended laterally after they are injected and relaxed with no occlusion. Cutting of the muscles

will be only except in the necessary in which the kyphotic necks have a good exposure is more important than paring the muscle. Oppel's Laryngeal hook has probably performed more parathyroidectomies than any one else used. A longitudinal incision along the anterior edge of the sternomastoid muscle from the jaw to the sternum. The incision allows exposure of the parathyroid is only on one side but one can never be sure on which side the parathyroidectomy may have to be performed. Only a few parathyroid tumors have been palpated before operation with approximate accuracy. Some tumors palpated

before operation proved to be small adenomata of the thyroid. Again sometimes it is impossible to find the parathyroid on one side when there are not large tumor formations and one is obliged to remove on either side whatever one finds—one or two bodies. Last it is better to have the whole field exposed so that one or better two parathyroids may be preserved. Therefore the longitudinal incision of Oppel is not to be recommended. In 51 cases in which Oppel presumably had removed a parathyroid it did not show any parathyroid tissue upon microscopic examination. The collar incision should be strictly recommended as the incision of choice as it allows inspection of both sides.

When the thyroid lobe is properly exposed it is first inspected on its anterior and lateral surfaces for parathyroids (8 to 9 per cent are located on the anterior 5 per cent on the lateral surface of the thyroid—Milgram). Then the lobe is gently turned medial to expose the structures posterior to it. This is best done with fine electric clips which are made to grasp the lobe without injury to the tissue. On the posterior surface the inferior thyroid artery is located between the carotid and gland (see illustration). By tearing apart the fine collateral tissue in this space with a fine tissue forceps usually the inferior parathyroid body is readily exposed and recognized by its size, shape and color. The superior parathyroid lies somewhat higher up usually at the junction of the upper and middle third of the thyroid edge. A little more blunt dissection of the areolar tissue will expose the recurrent nerve.

If no enlarged parathyroid is found on this side it is advisable to expose at the same time the parathyroids on the other side; the same applies. Then one is sure whether the disease is an actual tumor (adenoma) of the parathyroid present on either side or if one or several of the bodies are hyperplastic. The decision as to whether the tumor alone should be removed or even three parathyroids is difficult and depends upon the indications first if the symptoms the hypercalcaemia the decalcification of bones is very pronounced and endangers the patient it is better to remove three rather than two parathyroids. Otherwise it will be sufficient. In case of a definite parathyroid adenoma if certain size more removal of the same is probably all that is necessary. Second it should be seen

TUMORS OF THE MESENTERY

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TUMORS which originate within the leaves of the mesentery, because of their exceedingly uncommon occurrence, are looked on as unique surgical lesions. Nevertheless, even a cursory search of the literature reveals several hundred cases which have been observed, diagnosed, and reported.

In the files of The Mayo Clinic are records of 22 cases which we have reviewed and summarized, and now offer as additions to the literature on this subject. The bizarre clinical picture which most of these tumors present, the surgical difficulties which attend their extirpation, and their pathological identification are of no more interest than their development. The etiological factors concerned in the production of these tumors remain largely conjectural but, unquestionably, a certain number of them depend on congenital defects in the development of the mesentery for their explanation.

The embryology of the mesentery and its morphological relationship to neighboring structures is of unquestioned significance in the production of certain types, and probably of the majority, of these tumors. The primitive alimentary canal is developed within the cavity of the coelom, within the median partition which separates the right coelomic space from the left. This median partition suspends the primitive gut to the dorsal body wall and forms the dorsal mesentery, whereas that part of the partition which fixes the digestive tract to the ventral body wall constitutes the primitive ventral mesentery. However, the latter is formed only in connection with the foregut and the cloacal segment of the hindgut, all the remainder of the digestive tract is destitute of ventral mesentery. In the adult, the ventral mesentery is represented by the gastrohepatic omentum and the falciform ligament.

The fate of the dorsal mesentery is more complex than that of the ventral. Early in development, the coelom extends into the proximal segment of the umbilical cord, and it is within the umbilical recess of the peritoneal cavity that the midgut undergoes its earliest developmental changes. This U-shaped loop of gut is made up of a proximal jejunal and a distal, or cæcal, limb. As

rotation of the digestive tract takes place the jejunal limb comes to lie to the right and dorsal to the cæcal part. The mesoduodenum becomes adherent to the body wall, and about the tenth week of fetal life the umbilical loop of gut is retracted within the peritoneal cavity.

As the superior mesenteric artery descends to the intestinal loop, it gives off three branches to the posterior limb, these are the middle colic, right colic, and ileocolic arteries. The mesentery of the U-shaped loop is divided into two parts by this vessel. The pre-arterial part gives rise to the greater part of the mesentery of the small bowel, whereas the mesentery of the posterior limb, or postarterial part, is destined to form the mesentery of the ascending and transverse colon, and also the lower part of the mesentery of the small bowel.

When the rotation of the intestinal loop occurs, the splenic flexure of the colon comes against the spleen, while the transverse mesocolon comes into contact with that part of the mesogastrium which forms the great omentum and completes the formation of the transverse mesocolon. As is well known, the ascending and descending parts of the colon lose their mesentery after rotation has been completed, and become adherent to the dorsal body wall.

From an embryologic standpoint, it is conceivable that remnants of the wolffian or muellerian ducts, or segregated remnants of the genital gland can become lodged within the mesentery. The genital ridge develops lateral to the mesentery of the gut. The genital and the wolffian bodies each has its own mesentery, but these mesenteries have a common attachment—the common urogenital mesentery. The duct of the wolffian body is situated in the lateral margin of the genital ridge, dorsal to the muellerian duct. It is possible that portions of these embryonic structures might migrate in the retroperitoneal tissues to invade the mesentery of the bowel, and act as nuclei of mesenteric tumors in post-natal life.

Mesenteric neoplasms were recognized as early as the sixteenth century, when Benivieni, a Florentine anatomist, described the first cyst to be

Second The color of these epithelial bodies is a yellowish brown according to their fat content or blood content The most frequent mistakes made have been the removal of small thyroid adenoma lymph glands or fat tissue Thyroid tissue is easily recognized fat has no resistance to the examining finger and lymph glands while yellow pink are usually more round and regular in contour The parathyroids are usually more oblong and telltale reminiscent of a nerve ganglion If in doubt a frozen section should answer the question as to whether parathyroid tissue has been removed

Third At times identification of the parathyroid has not been accomplished at least in 3 such cases have been confessed to

Fourth In some cases primary ligation and division of the inferior thyroid artery will bring the yellowish brown parathyroid into view (E P Richardson)

Fifth Subtotal lobectomy has to be done frequently before the parathyroid can be exposed and removed Thyroparathyroidectomy is the operation most of the so-called surgeons who reported their cases have performed It has the following advantages before simple parathyroidectomy—it gives better exposure and more space for the delivery and handling of the parathyroids Some parathyroids are often imbedded in the thyroid and cannot be removed without more or less of a lobectomy (Willbuck 78 per cent) Furthermore the thyroid in parathyroidism is often goitrous and may contribute also to hypercalcemia and a thence conditions (Hunter) Therefore a thyroparathyroidectomy will be preferable in the majority of cases Only in children and if the thyroid appears normal and does not interfere with the technique should the parathyroids be removed alone (Most of our cases had associated adenomatous goiter)

After all these points—inspection of both sides of the neck for parathyroids—decide on as to how much of them to remove and subtotal thyroid lobectomy if needed has been done—the thyroid lobes or its remnant is dissected anatomically and the carotid and muscles laterally (see Fig 1) At this stage the recurrent nerve should be seen If necessary after ligation of the inferior thyroid artery the parathyroid body is lifted up with a fine mosquito forceps and is held until its nutritive artery appears starting from the inferior

thyroid or from a connecting branch from the superior thyroid This branch as well as the inferior is ligated if necessary with fine linen or silk (catgut slipped in one of our cases) The body can then be teased out of its areolar fibrous layer without bleeding The main fine branches providing ample vascularization of the parathyroid from thyroid laryngeal and pharyngeal branches as demonstrated by G Curtiss do not need surgical attention after the main ligation The wound is closed tight or with drainage as one prefers in goiter or not

In the after-care we have given as a routine 5 units of parathormone daily for a week after the operation Blood calcium is determined every day or two If it sinks below 7 the parathormonal dose is increased and calcium gluconate is given intravenously If tetanic symptoms occur obviously enough should be given to control the symptoms Blood calcium provides a good index as to the need and discontinuance of parathormone and calcium

It seems that postoperative tetany is not more to be feared after parathyroidectomy in parathyroidism than myxedema after the operation for Graves disease The handling of the recurrent nerve in one of our 18 operations caused difficulty on the operating table A tracheotomy tube left for 24 hours gave prompt relief without any lasting damage

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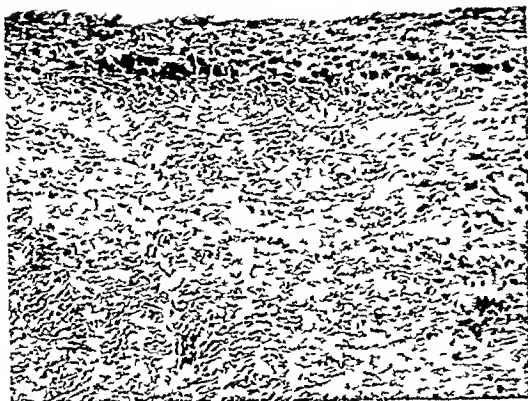


Fig 3 Wall of hæmorrhagic cyst Case 6

could be included within the folds of the mesentery, mesocolon, or mesorectum. He considered serous cysts to be of embryonic origin, whereas sanguineous cysts owed their nature to a hæmorrhage occurring into a preformed cyst. Carter was also of the opinion that many, if not all, of these cysts are of embryonic origin. He thought that they might arise from a Meckel's diverticulum, or from sequestration from the bowel during development, although obstruction of the lymphatic channels probably results in cysts in certain cases. Moynihan, on the contrary, sponsored the view that mesenteric cysts are of multiple origin. He thought that the serous type may have a two fold origin from a dilatation of a portion of a lymphatic vessel, occluded probably as the result of some inflammatory condition, or from a hæmorrhage between the layers of the mesentery. He considered the usual etiological factor in the formation of hæmorrhagic cysts to be trauma. Hæmorrhage into the mesentery may result in several alternatives, he postulated a large hæmorrhage may develop into a cyst, the hæmorrhage may occur into a pre-existing cyst, or into a solid tumor of the mesentery, the greater part of the solid constituents of the effused blood may disappear and a simple serous cyst result, or, finally, the fluid component of the blood may be absorbed and a more or less solid tumor persist. He further hypothesized that dermoid cysts may arise not only from remnants of ovarian tissue, but from the remains of the wolffian, muellerian, or vitelline ducts, the latter in connection with a Meckel's diverticulum. Porter subscribed to Moynihan's views in regard to the multiple origin of mesenteric cysts. Royster advanced the theory

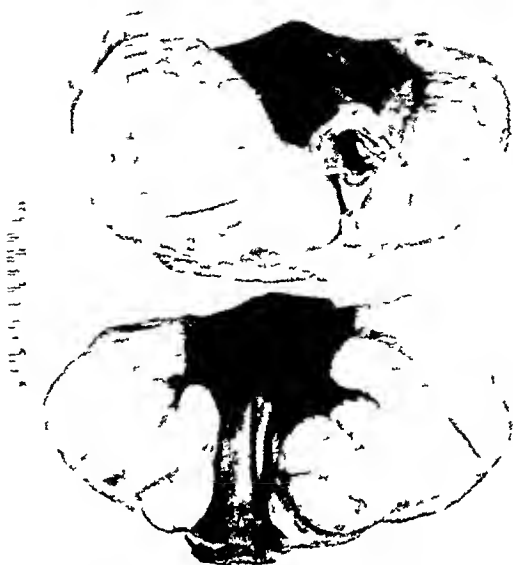


Fig 4 Hæmorrhagic cyst showing adherent section of intestine Case 7

that sanguineous cysts of the mesentery may be due to embolism or thrombosis of its vessels.

The pathogenesis of chylous cysts of the mesentery has been the subject of a long controversy. Rokitsansky was of the opinion that these cysts had their origin in degenerated lymph nodes, and his contemporary, Virchow, concurred with that view. Moynihan thought that possibly the underlying pathology of these cysts is a dilatation of the lacteals of the mesentery that is an exaggerated condition of lymphatic varix. Ewing (9) has stated that the chyle-angioma of the mesentery is a cavernous lymphangioma containing milky fluid which arises from congenital or from acquired obstruction of the lymph vessels. Spaeth thought that chylous cysts could be produced by stasis in the lymph passages coincident with formation of infarct, the infarcts being made up of dried masses of chyle, with a concomitant degeneration of the lymph nodes belonging to the system. In support of this view is the occasional finding of lymph nodes within the walls of these cysts. Dowd and Westman thought the foregoing theory untenable because of the rich anastomosis between the vessels of the lymphatic bed. Dowd was of the opinion that the chylous nature of the cyst is due to effusion of chyle into a pre-existing cyst. Wilson conceded that the latter view may be correct in certain cases, but he contended that the cyst may be primarily chylous in certain other cases. Crane regarded these tumors as true lymphangioma-lymphomata.

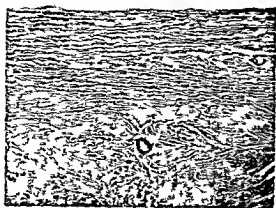


Fig. 111. Mesenteric tumor.



Fig. 112. Mesenteric tumor.

reported in that structure. Nevertheless little significance was attributed to these tumors until the middle of the last century. In 1830 Tillaux first successfully removed a mesenteric tumor and this undoubtedly did much to stimulate interest in the subject. Only since 1897 has careful study of these growths been made.

Due to our lack of knowledge concerning the pathogenesis of the various types of mesenteric tumor the classifications are necessarily at variance. In 1803 Portal (15) grouped these neoplasms as scirrhous, testomatous, stony, cancerous and hydatid. Moynihan introduced the following classification for mesenteric cysts: serous, chylous, hydatid, serous, dermoid and cystic malignant disease or cystic sarcoma. Doid employed a more inclusive grouping which was embryonic cysts, hydatid cysts and cystic malignant disease. Ewing (8) designated the tumors as chylous, enteric and dermoid cysts and intra-peritoneal cysts of nephrogenic origin. Raisz included the following tumors among the solid neoplasms of the mesentery: lipoma, fibroma, carcinoma and sarcoma.

In 1897 Moynihan estimated that 100 cases of mesenteric cyst had been reported prior to that time, whereas Harris and Herzog during the same year collected 57 cases of the solid type of tumor. In 1900 Dowd reviewed 145 cases of mesenteric cyst from the literature. In 1909 Deane found 39 additional cases. In 1914 Raisz stated that approximately 200 cases of cystic tumor of the mesentery had been reported. In 1916 Clark put the number at 300. In 1930 Joyce, Howard and Fitzgibbon estimated that between 200 and 300 cases had been described.

It is the consensus of opinion that cystic tumors of the mesentery are more prevalent than the solid variety, as has been stated by Jones and McClure and by Munn.

Mesenteric cysts of the chylous variety are more common than any other cystic neoplasm of that structure. Of the solid tumors the lipomata are said to be the most common, whereas Doid has stated that the fibromata are the most uncommon of the solid mesenteric tumors. Moynihan showed that multilocular cysts of the mesentery are more often encountered than those of the unilocular type, and furthermore that unilocular cysts are more common in the mesocolon than in the mesentery. The same author has stated that cystic mesenteric disease is much more common in women than in men, whereas the hamorrhagic type of cyst is found with about the same frequency in the two sexes. On the contrary, Joyce, Howard and Fitzgibbon expressed the belief that the incidence of mesenteric cysts is about equal in males and females.

These cysts may occur in any part of the mesentery. Doid thought that the neoplasms are most common near the termination of the ileum and are found less frequently in the mesentery of the jejunum, caecum and mesocolon.

Joyce, Howard and Fitzgibbon found that mesenteric cystic disease tends to be most prevalent in the decade of life between 30 and 40 years.

The origin of mesenteric cysts has been a matter of conjecture since the tumors were first described. Doid reviewed the anatomy of the primitive genito-urinary organs and the alimentary canal and postulated as to how readily a sequestration from the embryonic genital gland



Fig 7 Sarcoma with resected loop of intestine Case 15

found in the mesentery of the small intestine, 4 feet (120 centimeters) from the origin of the jejunum which contained 8 ounces (240 cubic centimeters) of milky fluid. The dilated lacteals were visible grossly. The wall of the cyst was made up of dense connective tissue with many collections of lymphocytes. A distinct endothelial lining membrane was demonstrable.

CASE 4 A woman aged 42 years noticed a mass in the lower part of the abdomen 5 years before coming to the clinic but there were no associated symptoms except an occasional attack of severe lower abdominal pain which was precipitated by turning about suddenly. At operation a cystic tumor of the mesentery of the upper part of the ileum was found which was adherent to the anterior abdominal wall as well as to several loops of the small intestine although there was no obstruction of the bowel. The microscopic picture of the tumor was similar to that of Case 1 except that the wall of the cyst was more cellular and contained less fibrous connective tissue.

CASE 5 A man aged 62 years gave a history of having had discomfort in the right lower quadrant of the abdomen for 2 years. It came on after meals amounting only to a feeling of fullness. A mobile tumor 7 or 8 centimeters in diameter was easily palpable. The tumor was found to arise in the mesentery of the small intestine opposite a Meckel's diverticulum and was easily enucleated without seriously impairing the blood supply of the intestine. The mass measured 9 by 9 by 7 centimeters and contained a milky fluid. The wall of the cyst was composed of dense connective tissue with many scattered collections of lymphocytes. Here also the wall of the cyst was lined with endothelium (Fig. 2).

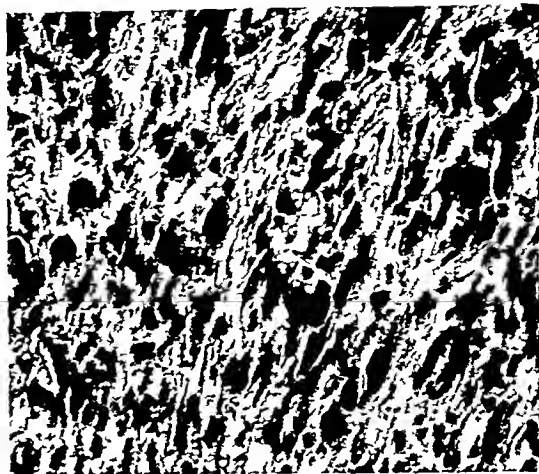


Fig 8 Sarcoma showing several mitotic figures Case 15

SANGUINEOUS CYSTS

The source of the blood in this type of cyst is a matter of conjecture. In neither of the cases of this series was a history of trauma elicited, nor was any co-existing condition found which could have been responsible for the hæmorrhage into the mesentery.

CASE 6 A woman, aged 39 years, had complained of intermittent, gnawing epigastric pain during the 2 years prior to coming to the clinic. The pain was not related to meals. At operation a cyst of the mesentery of the small intestine was found, it was 7 or 8 centimeters in diameter, and rested on the superior mesenteric vessels. The cyst was filled with dark blood. The wall was composed of fibrous tissue with considerable chronic inflammatory exudate, and without a demonstrable lining membrane. A moderate amount of blood pigment was present (Fig. 3).

CASE 7 A girl aged 6 years, had experienced recurrent attacks of vomiting during the 5 years previous to operation. The attacks had come on every 3 to 4 months with frequent vomiting for a period of 2 to 7 days. Intense pain in the lower part of the abdomen and bloody stools were associated with the attacks, and constipation was also a marked symptom. At operation a lobulated tumor, about 8 centimeters by 12 centimeters in different diameters was found in the mesentery of the ileum. The tumor was cystic and contained dark red fluid. The intestine above the mass was dilated and removal of the cyst necessitated resection of a loop of the intestine. The wall of the cyst was similar to that of the former case and here again no lining membrane could be detected (Fig. 4).

LIPOMATA

Lipomata are relatively common in the mesentery, and it seems highly probable that small, fatty tumors occur more often than is generally supposed. Fatty tags, and even larger accumulations of fat, frequently are found in the mesentery in the course of abdominal operations.

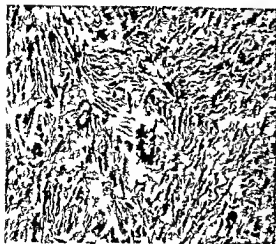


Fig 5 Fb my m C 3

The diagnosis of mesenteric tumors is difficult because of the multiplicity of symptoms produced by these growths. Moynihan has stated that the most characteristic signs of mesenteric cyst are (1) prominence of the fluctuating tumor to a d the umbilicus (2) great mobility especially in the transverse direction and sometimes about a central axis and (3) presence of a zone of resonance around and a belt of resonance across the cyst. These are three diagnostic signs of Tillaux.

Little need be said of prognosis in regard to mesenteric tumors. Benign cystic growths can be removed with only slight mortality whereas malignant tumors have as elsewhere given a poor prognosis.

The cases presented in this paper are all instances of primary tumors of the mesentery. Those arising secondarily to a growth elsewhere are neoplasms definitely arising in the lymph glands have been excluded. In the present series the cystic tumors occurred less frequently than the solid variety in the proportion of 7 to 5.

SEROUS CYSTS

To cases of serous cyst recorded in the present series. In neither case was a lining membrane demonstrable. The wall of the cyst although multiple ectos were made of both tumors.

CASE 3. A male aged 46 years, had a palpable mass in the right upper quadrant of the abdomen. The mass was found to be a large, fluctuating tumor. It was removed and found to be a large, thin-walled cyst containing clear fluid. The wall was composed of a single layer of cuboidal cells.



Fig 6 Fb my m C 4

CASE 4. A male aged 34 years, had a palpable mass in the right upper quadrant of the abdomen. The mass was found to be a large, fluctuating tumor. It was removed and found to be a large, thin-walled cyst containing clear fluid. The wall was composed of a single layer of cuboidal cells.

CHYLOUS CYSTS

The chylous cysts in the present series differed from the serous variety in important respects. Whereas the serous tumors did not possess an epithelial or endothelial lining, those of the chylous type had an endothelial lining of the chylous type. The chylous cysts occurred in the mesentery of the small intestine, as is true of the serous neoplasms. Definite lymphatic vessels could not be demonstrated in the walls of the cysts in any of these cases, although the contents may vary greatly in the accumulation of lymphocytes.

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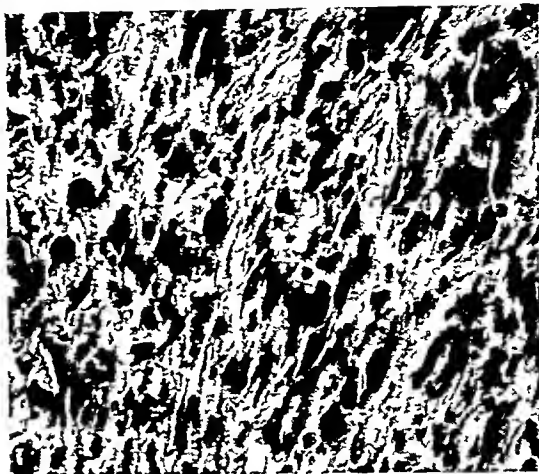


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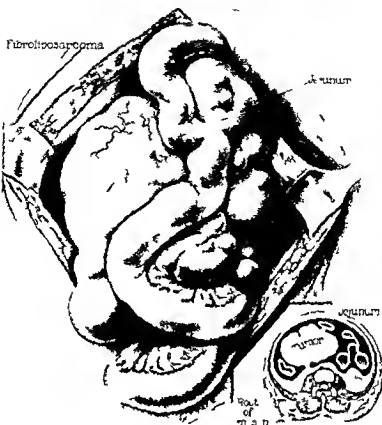


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FIBROMATA

These neoplasms are of interest chiefly because of their rarity and because of the fact that they are prone to be confused with malignancy growths of the mesentery. The cases are included in the present series of fibromyoma and the other of fibromyoma.

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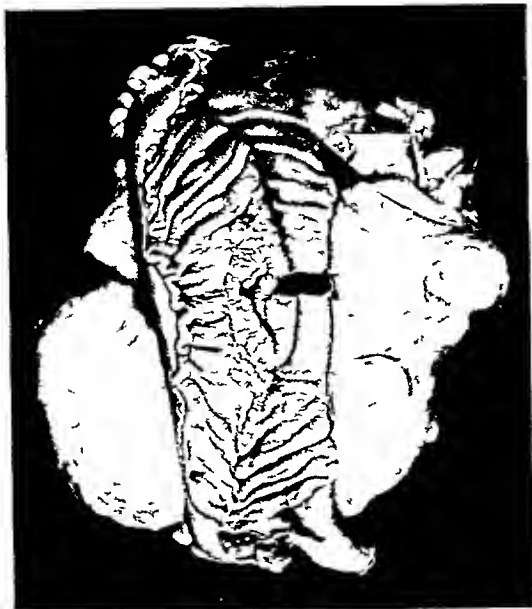


Fig 10 Sarcoma showing adherent section of intestine Case 20

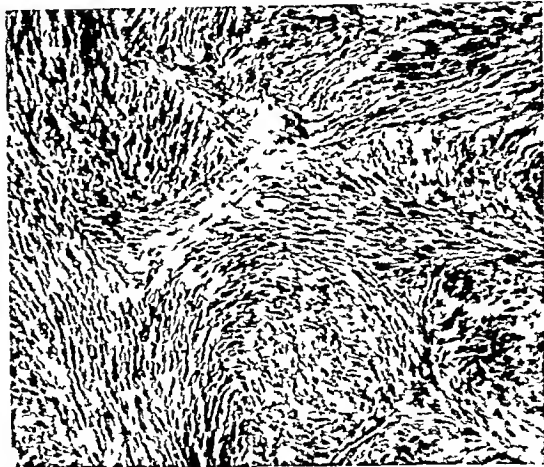


Fig 11 Sarcoma Case 20

smooth muscle cells, with a liberal amount of connective tissue stroma (Fig 5)

CASE 14 A man, aged 50 years, had experienced a sensation of epigastric fullness over a period of 10 years, the pain was aggravated by the taking of food. The only other pertinent symptom was increasing constipation. A large mass was felt in the lower right abdominal quadrant, and the superficial veins of the abdominal wall were enormously dilated. At operation a large tumor was removed from the mesentery of the small intestine. The growth measured 45 by 40 by 25 centimeters and weighed 25 pounds. It was composed largely of myxomatous tissue, with a considerable amount of fibrous connective tissue stroma. The tumor had undergone moderate necrosis in places (Fig 6)

MALIGNANT TUMORS

As already has been stated, all secondary tumors of the mesentery have been excluded from consideration. The number of cases of sarcoma exceeded that of any other single group of cases in the present series.

CASE 15 A man, aged 45 years, came to the clinic with a history of intermittent, cramp like pain across the lower part of the abdomen, of 4 months' duration. More recently he had had night sweats, and a daily elevation of temperature. He had lost 26 pounds (11.8 kilograms) in weight. Examination of the blood disclosed nothing of importance except mild secondary anemia, and a leucocyte count ranging from 23,300 to 33,000 cells in each cubic millimeter of blood. A large abdominal mass was palpable, and extended from the costal margin to the umbilicus. Laparotomy revealed a large sausage shaped tumor, the upper end lying over the spleen, and the lower end over the ileocaecal region. The neoplasm had its origin in the mesentery

of the small intestine, close to the duodenojejunal juncture and extended into the mesentery for a distance of 12 to 18 inches (30 to 45 centimeters). There was slight thickening of the musculature of the bowel, but no gross obstruction. The growth was removed, together with 45 centimeters of the ileum, an end to-end anastomosis was done over a clamp, and a Witzel enterostomy was done 10 inches (25 centimeters) below the point of anastomosis. The patient recovered. The tumor was found to be necrotic in places and was composed of fibrous connective tissue, with numerous regions of myxomatous tissue. Numerous mitotic figures were present, and the tumor was malignant in appearance. The pathologists diagnosed the tumor a fibroliposarcoma (Figs 7, 8 and 9).

CASE 16 A woman, aged 68 years, complained of dull distress in the lower left abdominal quadrant, of 3 years' duration, with an occasional cramp-like pain in this region. She had lost 20 pounds (9 kilograms) in weight. At operation, a mass, about 10 by 12 centimeters was removed from the mesentery of the small intestine through an opening in the gastrohepatic omentum. Microscopically, the tumor was found to be a fibromyosarcoma of a low grade of malignancy.

CASE 17 A man, aged 54 years, came to the clinic with a history of periodic attacks of epigastric distress of 6 weeks' duration. The pain was aggravated by the taking of food, and alkalies afforded him only slight relief. He had lost 15 pounds (6.8 kilograms) in weight in the course of his illness. An inoperable fibrosarcoma of the mesentery of the small intestine was found, and a palliative intestinal anastomosis was done.

CASE 18 A man, aged 44 years, complained of pain in the epigastrium in the lower left abdominal quadrant of 8 months' duration. Occult blood had been found in the stools 2 months prior to his coming to the clinic. Examination of the blood revealed marked secondary anemia. A cystic mass was found in the mesentery of the small intestine, arising 2 inches (5 centimeters) from the origin of the jejunum. The wall of the cyst was very vascular, and material aspirated from the tumor had a fecal odor, due to perforation of the intestine by the growth. The neoplasm proved to be a fibrosarcoma.

CASE 19 A man, aged 40 years, gave a history of shooting pain in the lower part of the abdomen of 18 months' duration. Except for increasing constipation, and loss of

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SUMMARY

Twenty t o cases f primary t mor of the mesentery ha e b en rev e d b efly. From an embriol gical po nt of vie t s c nceivable that mesenter c tumors may a se f om d splac d r m nants of the genital gla d olf an body o its duct or f om the muell nan duct. Nevertheless the e s no proof that any of the tumor described he e o d their patho enesis to such embry nic r mains. Ou d t ac tribution th ng to the o gin of serous cysts but du to th fact that an epi thelial i m g as not demonstrabl n th se tu mors t is c nceivable that they may ha e had their rign n h m r rhage t the mesentery the old c nst t ents of the blood ha ung b en absorbd. Th e dothelal lining f th chyl us cysts fav rs the v e that the e coplasms are due to dilatation of the lymph p ces ather than being due to eff s on f chylous mat r al into a prf med yst. The sanguine us cysts ould appear to be due to effus on of blood t to the mese tery and do n t se m to be hama go-mato s. The pathogene of the lipomata and

sarcoma s is ea ier to understand than that f the cyst c tumor

In this series the solid neoplasms occurred mo e frequently than the cystic variety and sarcoma c nstituted the largest si gle gro p f the series. The tumors shov d no definite predilect n for either se

The chylous cysts all occurred in the mesente v of the small intestine whereas such v as not necessarily the case v th the ther types f vst.

The progn sis of the benign tumors is favorable n spite of a pessim stic note having been strok n the literature on this point. In cases of mal g nant tumor the outlook s unfavo able

The diagnos s of mesenteric neoplasms s dubi cult but given a mob le abdominal mass e tr nse to the gastro inte ual tract the possibility f mesenteric neoplasm should be borne m m d. The occurrence of these tumors is p obably much more c mmon than has been believed

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NEPHROSTOMY INDICATIONS AND TECHNIQUE¹

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THE operation of nephrostomy, more or less formally done, has been in common use for more than 40 years. During the earlier period it was usually applied to much overdistended kidneys and was usually an emergency measure carried out without the possibility of any very complete knowledge of the condition of the upper part of the urinary tract. On the other hand, as early as 1898 there was a pretty full discussion of this subject by Guyon and Albarran. They drew attention to the apparently great ability of renal tissue to resist infection if it was not already present, and to shake off infection if it had occurred provided, always, satisfactory drainage of the kidney by nephrostomy was achieved. They noted the ability of the kidney again to take up its function "to an extent more or less complete according to the damage which has been produced. If the obstruction has been of short duration, function is but little disturbed. If the retention has been of long duration, it will have produced a more or less irreparable damage to the parenchyma and renal function is to that extent, permanently damaged."

Much of the literature concerns itself with questions of technique which have, of course, been much modified during the period elapsed. Pakowski, in 1913, presented an extensive discussion of this subject including a considerable investigation of the return of renal function and of the ability of the kidney to resist or rid itself of infection. He stated his agreement with the principles laid down by Albarran in 1898.

There thus appear to be two very important principles involved, one, the ability of the kidney to deal with infection, and the other the effect on renal function. Writers, particularly of the French school, stress the ability of the kidney

to deal with infection. On the other hand, other writers, particularly Joly, regard infection as a very serious matter, and Joly points out that in his experience infection of the kidney with urea-splitting organisms, particularly staphylococci and the proteus, gives a very unfavorable prognosis. He expressed the opinion that infection of one kidney with these organisms is very likely to be transmitted to the other kidney through the blood stream, and said "Once a bilateral infection is firmly established, the outlook is very bad, and the patient usually dies of uræmia. The process is necessarily slow, but it is none the less sure." This observation leads him to advise nephrectomy when such an infection has occurred in order to avoid involvement of the other side. These two sets of views are so much at variance that it seems desirable to attempt a collection of evidence which will determine which, if either, is to be regarded as basic.

The early observers were impressed by the rapid return of function among patients with high grade renal obstruction treated by this method. On the other hand, Hinman, in 1922 and subsequently, did some very important work on the problem of repair after obstruction and laid down the principles of what he termed renal counterbalance. These observations are obviously of very fundamental importance and, if we accept fully his thesis that, in the presence of hypertrophy of the kidney on the other side, an obstructed kidney is likely to go on to complete atrophy, many of the situations likely to appear favorable for nephrostomy should, in fact, be treated by nephrectomy. It is, of course, difficult to apply his doctrine to the cases which we see clinically because the situation is rarely if ever quite so clean-cut as in experimental work. That

¹Read before the American Association of Genito-Urinary Surgeons, Buck Hill Falls, Pennsylvania, June 4 to 6, 1931.



Fig 2 A man aged 8 y with bilateral pyelonephrosis. Left kidney is large and right kidney is hanging from the calyx.

his conclusions may not be quite so far reaching as suggested by the work of Joelson Beck and Moritz published in 1929 in which they went over the ground covered by Hinman and were unable to agree with his conclusions. They say quite dogmatically "Our experiments did not



Fig 3 Bilateral bilateral pyelonephrosis. Right kidney is large and left kidney is small.

demonstrate any real atrophy of disuse and in fact strongly suggest that such atrophy does not occur. In view of the experimental data presented the theory of renal counterbalancing need not be seriously considered in deciding the surgical treatment for certain renal lesions. This evidence of disagreement between capable experimenters may be taken to authorize at least to reserve our judgment as to the extent to which atrophy will occur where the injured kidney is working in competition with an hypertrophied kidney on the other side. As already pointed out the clinical situations are by no means as clear cut as those produced by experimental surgery and consequently the field of application of Hinman's doctrine may be considerably limited. We think we are at least authorized to regard the doctrine as a not very important factor to be considered in the clinical application of nephrectomy and we should be on sound ground by using the operation perhaps more judiciously than has been the habit in the past partly at least for the purpose of establishing clinical results and forming the basis for a prediction of the weight to be given to the quite opposite opinions held by such observers as Pakowski and Joly.

INDICATIONS

In general terms the indications for nephrectomy are the presence of obstructive nephropathy not satisfactorily remedied by some other method. There is also perhaps a satisfactory indication in preventing progressive injury to kidney.

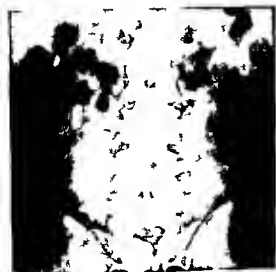


Fig 3 A man aged 8 years. Bilateral pyelonephrosis. The specimen is a large kidney, possibly the right one, showing the calyx and the ureter.



Fig 4 A woman aged 55 years Right calculous pyonephrosis



Fig 5 A woman aged 51 years Bilateral pyelogram showing right infected hydronephrosis, successfully treated by plastic operation on pelvis and temporary nephrostomy

neys in which there is incomplete obstruction which favors the continuance of infection as for instance in patients with bilateral calculous disease with steadily waning renal function. Another group with somewhat similar implications are those with inflammatory lesions perhaps primary in the bladder, but which have invaded the upper part of the urinary tract and in which drainage of the kidney is thus seriously and more or less permanently interfered with. Here also may be considered that group of patients with as yet unexplained lesions apparently of the nerve supply resulting in abnormal vesical function with dilated ureters and renal pelves. In both of these groups of cases renal function is apparently being slowly but steadily destroyed and will go on to the stage of renal insufficiency unless its progress is halted. If it is true that nephrostomy can be done without danger of progressive renal infection and if it is true that by nephrostomy renal function can be improved or maintained over a period of years, there develops here a relatively clear indication. In general one may consider the application of nephrostomy to the following conditions:

- 1 Acute obstruction of both ureters or of remaining one as in calculous anuria or malignant disease constricting the lower end of the ureter

- 2 Hydronephrosis or infected hydronephrosis in which the cause of the obstruction may be removable, but in which drainage of the kidney as a temporary measure is indicated to improve function. In this group of cases there may de-

velop some in which the nephrostomy may have to be permanent

- 3 Renal calculi. There are here at least two distinct groups for which nephrostomy temporary or permanent may be desirable. In one group are cases in which there is considerable destruction from high grade blocking of the outlet but in which the removal of stone will substantially relieve the difficulty. For some of these cases at least temporary nephrostomy may be desirable for the purpose of permitting readjustment be-



Fig 6 A man aged 34 years Right nephrostomy has been done and straight tube is in position. Calculi in left kidney may be noted

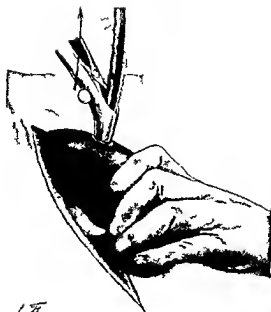


Fig 7 Method of phytomy

between the pelvis and the ureter to allow rapid recovery of renal function and at least possibly to aid in the quelling of renal infection.



Fig 8 1st method of phytomy

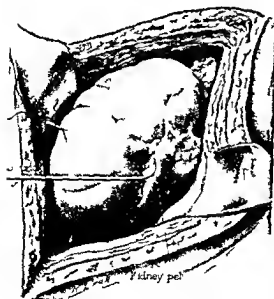


Fig 9 Method of tod g in so d t pet
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Another group includes cases of bilateral stone formation of the type which is not now regarded as satisfactory for treatment by removal of the stones. There is a considerable number of these in which massive infection occurs both sides though relatively few symptoms but after a time lead to progressive failure of renal function which will prove fatal if it cannot be relieved. It will be remembered that Watson in 1910 suggested nephrostomy for relief of some of these patients and on at least one patient he performed bilateral nephrostomy which maintained satisfactory renal function for more than 20 years. In this connection we would suggest that the case appears to us to be some possibility that nephrostomy maintained for a considerable period may have a very definite influence on the formation of stones although we do not think that the evidence on this point is as yet arrant. My conclusion is reached on the basis of Boyd's call attention to this point and at least one of the 15 cases that appeared to develop within a few months rapidly after nephrostomy. We think therefore that this group it may appear that the case is more than a general one which phytomy permanent or semi-permanent may be advised.

4 Nephrostomy may be helpful at least for the

present, be retained as an occasional method of diverting the urinary stream in carcinoma of the bladder thought suitable for total cystectomy

5 We would here include that obscure group of cases in which the failure of the muscular apparatus of pelvis, ureters, and bladder satisfactorily to evacuate the urine leads to progressive atrophy of the kidneys. This group will doubtless become increasingly amenable to treatment by other methods, but we are at present faced with a certain number of these patients in whom renal insufficiency threatens, relief cannot be assured by other methods, and nephrostomy may be relied upon to check further damage and perhaps allow for some measure of regeneration

6 We would here include a group of cases of renal infection without high grade obstruction in which the nephrostomy is done as a method of avoiding recurrent renal infection and allowing some amount of renal recovery

TEMPORARY OR PERMANENT NEPHROSTOMY

The decision as to whether nephrostomy should be temporary or permanent will not ordinarily be difficult. Permanent nephrostomy should probably be reserved for those cases in which the condition for which nephrostomy is done cannot be remedied or at least cannot be remedied to a permanently satisfactory extent. In a few cases nephrostomy which has been maintained as a temporary measure will have to be made permanent since methods to relieve the obstruction have failed. The duration of temporary nephrostomy will, of course, vary wholly with the conditions for which it is done. Thus the nephrostomy done for calculous anuria must be maintained until the calculus causing the obstruction has been removed and until recovery of renal function appears to be satisfactory. Such drainage might continue for from 3 to several weeks. In the same way, the nephrostomy which is done in connection with plastic operations on the renal pelvis will be continued until it is judged that the healing of the operative wound has become satisfactory. Finally, nephrostomy which is done in connection with the removal of renal calculi will vary in its duration according to the condition of the kidney and according to the development of our belief that nephrostomy with its attendant possibilities of altering the physical conditions within the kidney may be used to affect the rapidity or probability of recurrence of stone

NEPHROSTOMY VERSUS PYELOSTOMY

It will be proper at this time to indicate our opinion of the relative value of nephrostomy and

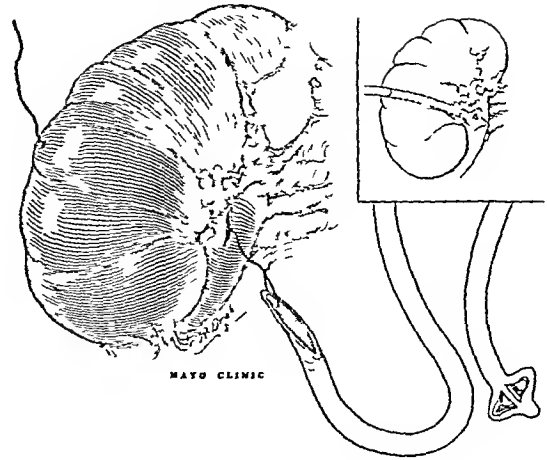


Fig 10 Use of silk guide to draw winged catheter into proper position in renal pelvis

pyelostomy as a method of temporary drainage. In the presence of a distended renal pelvis and particularly when that structure has been opened for the removal of calculi, drainage of the renal pelvis has been regarded as the obvious and simple method. It is, we believe, open to certain objections which have in our experience considerably limited its use. It is much more difficult to retain the drainage tube accurately in the renal pelvis if drainage is to be continued for more than 1 or at most 2 weeks. The accurate replacement of the tube is difficult and not rarely impossible and it commonly occurs that a tube slips out of the pelvis before satisfactory drainage has been accomplished, cannot be accurately replaced, and drainage has to be abandoned. It has also been common in our experience that although the drainage tube may remain in satisfactory position for a matter of 10 days or 2 weeks when it is desired to remove it and replace it by another tube, such replacement has been inaccurate and the result unsatisfactory. The operation has been regarded as desirable because it did not injure renal tissue, did not expose to the same danger of fulminating renal infection as might occur in an infected kidney, and was in all respects a much less serious procedure. We hope to be able to show that nephrostomy may be done by methods which will make it a quite trivial procedure and much less exposed to the above mentioned objections than when carried out by methods more generally in use. On the whole, we incline to the opinion that pyelostomy has a much more limited scope than nephrostomy and one which will tend to become even more limited in the future.

SUMMARY OF CASES OF NEPHROSTOMY

During the last year we have performed nephrostomy in 33 cases and these may be used to illustrate our suggestions in regard to its application.

Nephrolithiasis. In this group there have been 14 cases of which 7 were instances of bilateral stone. There were 6 instances of unilateral stone with seriously injured kidneys in which the method was employed in the attempt to preserve the kidney. One as a case of a single remaining kidney the other having been previously removed elsewhere for calculous disease. The patient had had two recent attacks of calculous anuria.

In all of the cases of bilateral nephrolithiasis the urine was seriously infected. Two patients had been previously operated on with rapid reformation of the stone, the renal function of both as measured by the return of phenolsulphonephthalein was markedly below normal. The operation was used in all these cases as a method of attempting to improve renal function and by local treatment of the renal pelvis to alter perhaps the rapidity of recurrence (Fig. 1). In all cases the immediate results were satisfactory. We cannot of course form any judgment as to the late results. In some cases the condition of the kidney at operation seemed very bad yet we hesitated to do nephrectomy on account of the condition of the other kidney. It was surprising to note that in 3 cases kidneys which at operation apparently contained nothing but stone and pus within 24 hours were putting out a normal quantity of fairly satisfactory urine both from the point of view of appearance and the point of view of function (Fig. 2). At least as a temporary measure nephrostomy in these cases seemed well worth a trial.

In 3 of the 6 unilateral cases stones were firmly impacted in the upper part of the ureter with no clear evidence of renal function on that side (Fig. 3). However at operation the amount of excreted renal substance seemed too great to sacrifice and nephrostomy appeared to show that this judgment had been sound. In the 3 other cases the stones lay in pelvis or kidney but again the amount of remaining renal tissue seemed too great to sacrifice although the function was very poor before operation (Fig. 4). This small experience suggests to us that this method may permit the retention of a certain number of kidneys which have heretofore commonly been removed on account of the evidence of injured function. In the present state of our knowledge it is doubtful whether we have any test of the function

of a stone-containing kidney on which we can rely as an indication of the permanent function of that kidney.

The remaining case in this group was that of a woman whose left kidney had been removed elsewhere 3 years ago on account of stone. During the last year she had had two attacks of anuria. Before operation the total renal function was below 20 per cent although there was no elevation of nitrogen in the blood. Operation revealed a much dilated and apparently considerably injured kidney but after nephrostomy this kidney drained freely its function improved and 4 months later the output of phenolsulphonephthalein was 40 per cent. In this case the nephrostomy was made permanent.

Hydronephrosis. We include here 5 cases of hydronephrosis apparently due to congenital anomalies in which plastic operations were done on the renal pelvis. In these cases temporary nephrostomy was done in order to allow time for accurate healing of the wound of the pelvis (Fig. 5). In all of these cases the tube was removed in 4 to 6 and 2 and 3 weeks and the condition of the kidney at that time seemed satisfactory. This method has seemed to us preferable to draining through the pelvis in such cases and we believe that some method of drainage other than that which can be obtained through a ureteral catheter is desirable.

Lesions of the ureters. The next group is composed of 4 cases of obscure neurological lesions resulting in failure of the urinary musculature apparently throughout. In these cases nephrostomy was resorted to in the hope of stopping progressive renal injury. One was the case of a man aged 24 years whose difficulty apparently followed a gun shot wound of the abdomen. There was extensive pyonephrosis on both sides with dilatation of pelvis and ureters. Bilateral simultaneous nephrostomy was done after serious renal insufficiency had developed and the concentration of nitrogen and creatinine in the blood was rising. The operation failed to stop the injury and death occurred 2 weeks after operation. Another case was that of a female child aged 3 years with congenital anomalies of the nerve supply and infectious purpura apparently due to bilateral infected hydronephrosis. Her condition was very bad and nephrostomy was done on the left side. It failed to improve the process. Another was a child aged 5 years with a similar lesion but less infection. Nephrostomy as done on the right side with drainage of a much damaged kidney with an enormous ureter. Very marked improvement in general condition took place and the

patient was dismissed with the nephrostomy tube in place. The remaining patient of this group was a man aged 34 years who had had urinary symptoms suggesting extensive infection of the urinary tract for many years. Careful urologic study showed right hydronephrosis with great dilatation of the ureter, but with no clear evidence as to cause other than a congenital nerve lesion. On the left side there was complete duplication of ureter and pelvis with two stones in the lower segment, considerable dilatation of the ureters, but good function. Study 4 months later showed that the function of the right kidney had diminished to almost nothing and the ureter on this side could not be catheterized. In view of the situation on the left side it seemed as if an attempt should be made to retain the right kidney if possible (Fig 6). Nephrostomy was done and a month later the phenolsulphonephthalein function from this kidney was 20 per cent while that on the left side was 25 per cent. This patient was advised to return for operation on the left side for the removal of stones.

Obstruction of lower ureter. The next group consists of 3 cases of obstruction of the lower part of the ureter. One was a case of bilateral injury to the ureter at the time of an operation for carcinoma of the uterus. In this case bilateral simultaneous nephrostomy was done which gave satisfactory and adequate drainage. This patient was reported to have died 6 months later, probably from malignant disease. Another patient was also the subject of malignant disease of the uterus under treatment with radium. The disease had obstructed the right ureter and destroyed the right kidney more than a year previously. While under treatment with radium here sudden anuria developed and examination showed impassable obstruction of the remaining ureter. Nephrostomy was done within 24 hours with a most satisfactory result. The third patient was a man aged 52 years whose right kidney had been removed for pyonephrosis in 1927. In 1928, he had a perineal operation for prostatic calculi, and in March, 1931, a cautery operation on the neck of the bladder through the urethra. The latter part of April oliguria began to develop and finally anuria, and catheterization of the left ureter was impossible on account of deforming scar. Nephrostomy was done with an excellent result. At the present time, a varying amount of urine is passed from the bladder. The ureter is not entirely obstructed but seems unable to take up its full function. Nephrostomy in this case was done in order to give an opportunity to make any necessary attack on the ureter possible.

Renal infection. The next group includes 3 cases of infection of the urinary tract with extensive renal injury. The first concerned a man aged 45 years with a long history of a painful infection of the bladder with final contraction of the bladder and infection of the upper part of the urinary tract. All methods of treating the bladder were unsuccessful and he suffered from recurrent attacks of renal infection first on one side and then on the other. Cystostomy had been tried and had failed. His condition seemed so bad that the chance of benefit by nephrostomy seemed worth taking. This was done on the right in February, revealing a battle scarred kidney without dilatation but with much thickening of the pelvis and ureter. Following nephrostomy his condition improved very much. Two months later he had relapse of the infection in the left kidney. This, interestingly enough, entirely interrupted the function on that side and for nearly 2 weeks the right nephrostomy carried on total function. Then the infection on the left quieted and the function of that kidney returned with rapid subsidence of the urinary output on the nephrostomized kidney. It is our intention to operate on the left kidney in view of the apparently marked improvement of the condition of the right. This case throws interesting light on the behavior of a kidney during acute infection. Another case was of a somewhat similar type with prolonged infection of the urinary tract, extensive injury to the bladder and ureters with recurrent attacks of renal infection on both sides which had resulted in very grave injury so that there was marked elevation of blood urea and a phenolsulphonephthalein excretion of 20 per cent in 2 hours. Pyelogram of the kidneys showed moderate bilateral infected hydronephrosis. Bilateral nephrostomy was done in two stages and the patient left the hospital a month after the second operation with marked improvement of renal function and in good condition. The remaining case in this group was an obscure one with probable renal tuberculosis on one side and obstruction of the ureter on the opposite side. Nephrostomy was done as an emergency measure for threatened anuria with blood urea of 152 and creatinine of 4 milligrams in each 100 cubic centimeters. Marked improvement occurred after operation and the patient went home with a satisfactorily draining nephrostomy. He died 4 months later, probably of tuberculosis. These cases are introduced simply to indicate a possible field for the use of nephrostomy in the treatment of certain cases of advanced renal infection.

Carcinoma of the bladder The 4 remaining cases were of patients with extensive carcinoma of the bladder producing ureteral obstruction. Nephrostomy was done as a temporary measure to prolong comfortable existence but without any expectation of prolonged benefit on account of the extensive involvement of the bladder. The results seemed to have justified the operation.

Mortality In this group the mortality should be credited to the operation in 3 cases. Two patients had extensive bilateral infected hydro-nephrosis apparently due to abnormality of the nerve supply. The condition of these was desperate and the patients died really of the disease and not of the operation. One of the patients had extensive carcinoma of the bladder in which nephrostomy was done as a late measure. Our experience in regard to mortality is similar to that of all other observers namely that the operation itself is relatively safe but as it is frequently done for serious or desperate conditions it will be associated with the mortality properly to be expected in these situations.

Bleeding Bleeding did not occur following operation.

Infection We have had no instance of fulminating renal infection although this will doubtless occur in an occasional case in which any operation is done involving the renal parenchyma in the presence of existing infection. The effect of the operation on pre-existing infection has during this brief period been satisfactory. There has regularly been prompt improvement of infection although it is of course as yet too early to express any opinion as to the ultimate effect.

Calculus We feel particularly interested in the patients with bilateral extensive calcareous disease since it seems possible that prolonged drainage of the kidney by this method may preserve remaining renal function and may influence the rapidity and extent of stone formation. On this point it is highly desirable that prolonged observation should be made.

TECHNIQUE

In the early days the operation consisted of a considerable nephrotomy along the convex border with the division of much tissue to enable the drainage tube to be accurately placed in the pelvis. This method has been practically wholly abandoned and has been replaced first by the method of Marion which introduces a dilator through the cortex of the kidney through which the tube is passed (Fig 7). Later was developed the method of opening the renal pelvis and passing a curved instrument out through the

cortex at the desired point by means of which the drainage tube is drawn down into the pelvis and placed accurately in position. Papin in 1927 advised the method of Marion for temporary nephrostomy and the method of introducing an instrument into the renal pelvis for permanent nephrostomy. He at that time advised the use of a winged catheter which was important in overcoming the very considerable danger that the tube would become displaced work gradually out into the substance of the kidney and finally fail to drain the kidney at all (Fig 8). One of the common and annoying complications of nephrostomy is this displacement of the tube. There is no structure of the kidney to which a tube can be safely and satisfactorily attached but the use of a winged catheter seems to overcome this objection and maintain the tube in accurate position until such time as the drainage tract has become satisfactorily established.

The technique which we are suggesting is put forward as an improvement on this latter method. We have encountered a large number and perhaps a fair proportion of the cases in which the mobilization of the kidney sufficient to allow a curved instrument to be readily introduced into the pelvis and passed out through the desired point on the cortex is either impossible on account of the fixity of the kidney or involves an amount of preparatory dissection which unnecessarily prolongs and complicates the operation. In not a few of these cases particularly those in which a bilateral simultaneous nephrostomy is indicated the element of time is of importance and it has seemed to us that a method which could be employed without extensive mobilization of the kidney was desirable. There is also a certain number of these cases in which there is no dilatation of the renal pelvis in which it may in fact be entirely intrarenal and in which the introduction of an instrument as illustrated by Papin has in our hands been difficult.

The method which we suggest is as follows. The kidney having been exposed and mobilized to an extent to give access to the upper part of the ureter and the renal pelvis a small opening is made in the pelvis although in the case of the intrarenal pelvis it may actually be made in the ureter. A uterine sound with a slightly bulbous tip bent in U shape is introduced into this opening and passed out through the cortex at the point selected (Fig 9). This point should be thought to be placed so as to drain the lower calyx as the most efficient method of draining the kidney but it should also be placed in relation to the convex border of the kidney in such a way that

the drainage tube will lead straight from the wound and not be exposed to angulation as the kidney falls back into its normal position. This point can be readily ascertained by seeing where the kidney will most comfortably lie, and the sound, which has been introduced into the pelvis, is pushed out through the cortex at that point. A piece of stout silk is then attached to the bulbous tip, withdrawn through the kidney and out of the opening in the pelvis and to this is attached the winged catheter (Fig 10). As a rule we use a winged catheter of no. 22 to 24 French. The end of this catheter should be trimmed off to a point. Traction on the suture then draws this catheter accurately along the line created by the sound, and it fits so tightly in the renal parenchyma that bleeding will be entirely controlled. As a rule we have not thought it necessary and perhaps not wise to close the small opening made in the renal pelvis but have allowed this to remain until it closes spontaneously, which will as a rule take place within a week. This winged catheter is not fastened to the kidney or to any portion of the overlying tissues and the kidney is thus allowed to decide for itself, so to speak, the position in which it prefers to lie. The drainage from these catheters has been eminently satisfactory. Experience has led us to the opinion that they should be left in place for about 2 weeks at which time a straight tube can be substituted. For this purpose we use a no. 22 rectal tube which has an opening in the end and in the side. The removal of the catheter is facilitated by passing through it a stylet when traction on the catheter will smooth out the wings of the catheter so that it does not lacerate the renal tissues. If the straight tube is immediately replaced and if care is taken to see that it penetrates for exactly the same

distance, most satisfactory drainage can thus be obtained. After the first change there has been no subsequent difficulty and after a few weeks the patient can as a rule have the tube changed by some member of the family.

This technique seems to us to involve less injury to renal tissue than previous methods. By drawing the tube outward through an opening much smaller than its own dilator the oozing from the renal parenchyma is entirely controlled. We have seen little if any bleeding following the procedure and have as yet seen no immediate or fulminating infection although it may be admitted that any laceration of the renal parenchyma will under suitable conditions of previous infection give rise to this dread complication.

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NUPERCaine SPINAL ANÆSTHESIA

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THE following is a report of the experience with the use of the drug nupercaine (Ciba) in spinal anesthesia at the Mount Sinai Hospital in New York City. This drug known as percaine in Europe has been used extensively as a local anesthetic but this report will be confined to its use in spinal anesthesia.

The *chemical and physical properties of nupercaine* are: Nupercaine is a quinoline derivative—alpha butyl oxy cinchoninic acid diethyl ethylene diamide bydrochloride. It occurs in the form of colorless crystals which are readily soluble in water. Distilled water and chemically pure sodium chloride should be used for preparing the solutions. These solutions may be boiled repeatedly without decomposition. Very slight alkalinity decomposes the salt with precipitation of the base. Thus it is essential that no alkali come in contact with the solution. Any alkalinity derived from glass containers may be counteracted by adding 5 minims of dilute hydrochloric acid to each liter of solution. The drug is manufactured in convenient ampules of 2 cubic centimeters of 1.00 in a buffered sodium chloride solution for use in spinal anesthesia.

Toxicity of nupercaine.—From investigations on laboratory animals reported by Uhlmann, Ipschitz and Laubender, Gessner and Nauheimer and more recently by Bond and Bloom, it is evident that nupercaine in certain concentrations is a toxic drug. The toxicity varies from 10 to five times that of cocaine. On the other hand, when solutions of nupercaine and cocaine are injected subcutaneously into dogs it would seem that the toxicity of the two substances is practically the same (Bond and Bloom). This may be explained by the fact that the subcutaneous fatal dose of nupercaine is approximately eight times the intravenous dose, whereas with cocaine the ratio of subcutaneous and intravenous toxicity is 10 to one. An absolute comparison of the relative safety of nupercaine and other local anesthetics in man requires further clinical experience. It should be noted that being a very powerful anesthetic agent ten times as anesthetic as cocaine, nupercaine is effective in such high dilutions that toxicity in practical use is reduced to a minimum. Nupercaine is rapidly eliminated or detoxicated by the body (Bond and Bloom). The mechanism of elimination of the

drug has not been sufficiently investigated. It is believed that the liver plays an important part in its destruction.

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REVIEW OF LITERATURE

The first clinical report on the use of nupercaine was that of Christ. He stated that good spinal anæsthesia was obtained with 4 cubic centimeters of 1:1000 solution. General toxic reactions were not observed.

De Weerdts has employed nupercaine for spinal anæsthesias in 151 cases for all sorts of operations. He noted that anæsthesia and paralysis of the legs occurred some minutes later than with other anæsthetics. There were often some sensitive zones, the cause of which was probably due to improperly prepared solutions. The patients looked better than when other anæsthetics were used. Vomiting occurred less frequently. A sudden cardiac weakness occurred in some cases a few minutes after the injection, but this was successfully combated by means of intravenous injections of caffeine. He commented on the long duration of the anæsthesia, and was well satisfied with his results.

Eichhoff's experience with nupercaine in various strength solutions for spinal anæsthesia in 9 cases, was rather unsatisfactory. The experience of Floorcken and Mues with nupercaine spinal anæsthesia was unsatisfactory. In 3 cases, 4 cubic centimeters of 1:1000 solution produced a good low anæsthesia, in 7 additional cases it was entirely inadequate, in 2 cases 1 cubic centimeter of 1 per cent solution was followed by severe collapse in 1 case and insufficient anæsthesia in the other.

Iwata employed nupercaine in 20 abdominal operations, 4 to 5 cubic centimeters of 1:1000 solution being used. There was complete anæsthesia in 16 cases, in one instance sufficient for an operation lasting 1 hour, 46 minutes. In the 4 remaining cases, there was a suspicion that the syringe was not alkali free. In one of these cases inhalation anæsthesia had to be used. Twelve patients had no post-operative pain. Headache was never observed, but some gastric discomfort and vomiting occurred generally the day after operation.

Jastram reported his experiences with nupercaine for spinal anæsthesia in 12 cases. The anæsthesia lasted at least 5 hours. He used 0.75 to 1 cubic centimeter of 1 per cent solution.

W. H. Jones has employed nupercaine for spinal anæsthesia in over 200 cases. He used the higher dilutions of the drug, the duration of the analgesia being proportional to the concentration of nupercaine. For operations of about three-fourths of an hour, 1:2000 was effective, for 1 hour or more, 1:5000, for 2 hours and beyond, 1:1000. The maximum dosage was 18 milligrams, although 7½ milligrams was satisfactory for most laparotomies. For anæsthesia of the dorsal roots, the injection was made between the first and second lumbar vertebrae, for anæsthesia of the sacral and coccygeal plexuses, between the first and third lumbar vertebrae, and for blocking of the cauda, between the fourth and fifth lumbar vertebrae. Only a few drops of cerebrospinal fluid were allowed to escape, and the solution was injected directly. The patient was then turned directly on his face for about 5 to 10 minutes or even longer if the operation was likely to be prolonged. Jones did this because he found that many of the nupercaine solutions used had a specific gravity less than that of the cerebrospinal fluid, and in the dorsal decubitus there is therefore a predominating anterior root block with little or no effect on the posterior roots. Thus the entire abdominal musculature may be paralyzed, and

yet the anæsthesia be a poor one. The patients were therefore placed in the ventral decubitus in order to soak the posterior roots and develop analgesia, and when patients were finally put in the dorsal position, paralysis of the anterior roots would naturally follow and would outlast the analgesia if the time allowance on the posterior roots had been too short. Jones noted a fall in blood pressure due to vasomotor paralysis, but the fall was not nearly so great as with large doses of novocain or stovaine. The patient's color and appearance were usually excellent. He claims that this relative non-toxicity is not a property of the pharmacological action of nupercaine, but is due to its high dilution which makes sudden absorption into the blood stream impossible. Spontaneous vomiting was rarely seen on the operating table for this reason. There may develop some degree of respiratory embarrassment, due to a paralysis of the intercostal nerves owing to the predominating anterior root effect of the nupercaine solution. Jones states that failures with nupercaine mean faulty administration. In discussing the after effects of the anæsthesia, Jones states that the usual spinal headache had followed in several cases, sometimes severe and lasting several days, but no more so than with solutions of novocain. Several cases of severe vomiting occurred early in the series, but this number has decreased. The incidence of headache and vomiting had no direct relationship to the amount of nupercaine injected. In this report there had been no fatalities. The report of a death in a later series has been discussed previously.

The first report in the American literature was that of Keyes and McLellan (14). They used nupercaine for spinal anæsthesia in 46 cases. High dilutions of the drug were first used, but the dosage used in 28 cases was 2 cubic centimeters of 1:200 solution (10 milligrams). No intoxications or paralyses were observed. There was one spinal headache. The anæsthesia was used in 24 suprapubic bladder operations, 9 kidney operations, 11 urethral and intravesical operations, and in 2 patients in whom spinal anæsthesia was used to control renal colic. The anæsthesia was perfect in 36 cases, and had to be supplemented in 10 cases. No alarming symptoms were observed during operation. Vomiting during the operation did not occur, and only 3 patients vomited thereafter. The systolic blood pressure of 20 patients fell an average of 18 points, that of 12 others did not fall. The maximum fall was 70 points. Ephedrine was used in all cases. The duration of anæsthesia varied from 1½ to 12 hours, the average being 7 to 8 hours. Nine patients did not complain of any post-operative pain, but all open operations required sedatives the following night. Accurate studies of blood pressure changes were made in 41 cases, and compared to procaine (120 milligrams) and spinocaine (200 milligrams). The average maximum fall in blood pressure after procaine was 31 millimeters, after spinocaine 39 millimeters, and after nupercaine 18 millimeters. There was a rise in blood pressure above the ante-operative pressure in 11 nupercaine cases, 4 procaine cases, and 3 spinocaine cases. The blood pressure began to return to normal as soon after nupercaine as it did after procaine, and an initial sharp drop in pressure after nupercaine did not usually imply a further drop of 30 to 50 millimeters as would be the case after procaine. No deaths were reported.

At a recent meeting of the American Society for Regional Anæsthesia in February, 1931, McLellan (15) reported on further experiences with nupercaine. He reported 215 anæsthesias in 159 patients. The highest anæsthesias were for kidney operations—41 cases. The remainder were for operations below the umbilicus. Two-thirds of the patients were below 50 years of age—the youngest 16 and the oldest 80. The dosage used was 10 milligrams, 2 cubic centi-

NUPERCARINE SPINAL ANÆSTHESIA

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Chemical and physical properties of nupercaine. Nupercaine is a quinolinederivative—alpha butyl oxy cinchoninic acid diethyl ethylene diamide hydrochloride. It occurs in the form of colorless crystals which are readily soluble in water. Distilled water and chemically pure sodium chloride should be used for preparing the solutions. These solutions may be boiled repeatedly without decomposition. Very slight alkalinity decomposes the salt with precipitation of the base. Thus it is essential that no alkali come in contact with the solution. Any alkalinity derived from glass containers may be counteracted by adding 5 minims of dilute hydrochloric acid to each liter of solution. The drug is manufactured in convenient ampules of 2 cubic centimeters of a 200 in a buffered sodium chloride solution for use in spinal anesthesia.

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drug has not been sufficiently investigated. It is believed that the liver plays an important part in its destruction.

The following deaths after injection of nupercaine into the spinal canal are taken from the literature.

Heckenbach has reported in a patient, 38 years old, paralytic with a spinal cord tumor, the proposed administration of para-ether anesthesia prior to a lumbar puncture. The patient died of a cerebral aneurysm. It is believed that the death was due to the use of the drug in the spinal canal. The patient had been given a lumbar puncture and had been given a lumbar puncture. The patient had been given a lumbar puncture and had been given a lumbar puncture.

W. H. Jones (3) reported the death of a woman, 5 years old with multilocular aneurysm extending to the spinal margin. She was given 4 cubic centimeters of 500 solution of percaine between the first and second lumbar vertebrae and the placed in the spinal position. All with light percaine solution to the spinal canal with the spinal cord. In 10 to 15 minutes collapse occurred. The patient was turned on her back and the spinal puncture was made. The patient was given a lumbar puncture and had been given a lumbar puncture.

Jones is of the opinion that the central position in patients with large abdominal tumors is a mistake. Pressure on the diaphragm can be transmitted to the heart. He feels that the small amount of nupercaine about 9 milligrams could not exert a systemic action sufficiently great to cause death.

3. Steinbrück reported the death of a 60-year-old man with diffuse peritonitis after spinal injection of 5 cubic centimeters of 1 percent solution of percaine.

4. K. J. and McLellan (4) reported 2 deaths. The first case was that of a patient with an aneurysm of the aorta. The patient was given a lumbar puncture and had been given a lumbar puncture. The patient was given a lumbar puncture and had been given a lumbar puncture. The patient was given a lumbar puncture and had been given a lumbar puncture.

5. The second case was cardiac failure. The patient was given a lumbar puncture and had been given a lumbar puncture. The patient was given a lumbar puncture and had been given a lumbar puncture. The patient was given a lumbar puncture and had been given a lumbar puncture.

TECHNIQUE

In most cases, the individual surgeon acted as his own spinal anæsthetist, the patient being carefully observed throughout the course of the operation by a regular nurse staff anæsthetist.

Dosage of drug In nearly all cases, the dose of nupercaine was 10 milligrams—2 cubic centimeters of 1:200 solution. In 3 cases, the dose was $7\frac{1}{2}$ milligrams, and in 1 case, 5 milligrams.

Position of the patient The lumbar puncture was done with the patient either in the sitting or in the lateral position. Immediately after the injection, the patient was placed in slight Trendelenburg position.

Preliminary medication Morphine and atropine were administered prior to the procedure in nearly all cases, and codeine and atropine in a few. Ephedrine was given in 101 cases. The usual dose of ephedrine was 50 milligrams.

Level of injection The level of injection was specifically noted in 60 cases. In 14 of these, the injection was administered above the second lumbar vertebra and in 46 below that site.

Blood pressure changes Accurate blood pressure determinations were recorded in 84 cases. In 66 cases there was a fall in blood pressure of from 10 to 150 millimeters of mercury. This fall occurred in most cases within 15 minutes following the injection of the anæsthetic. Marked drops in blood pressure (50 millimeters or more) were noted in 26 cases. In nearly all cases in which a fall in blood pressure was observed, ephedrine had been used prior to induction. In 16 cases there was a rise in blood pressure which was maintained above the ante-operative blood pressure throughout the course of the operation. The rise in most cases was within the first 10 minutes. Ephedrine was used in all these cases. In 2 cases there was no change in the blood pressure.

We were particularly interested in the blood pressure changes in patients with hypertension (systolic blood pressure above 150 millimeters) and hypotension (systolic blood pressure below 100 millimeters). Of the 10 patients with hypertension, 9 had falls in blood pressure of from 50 to 150 millimeters of mercury. All of the 4 patients with hypotension had a rise in blood pressure of from 20 to 40 millimeters of mercury. From this and other studies we are loath to use spinal anæsthesia in patients with marked hypertension. Marked drops in blood pressure in these patients are often accompanied by severe clinical manifestations. On the other hand, we do not feel that hypotension, in itself, is ever a contraindication to spinal anæsthesia.

No relation could be determined between the

changes in blood pressure and the level of the injection. Striking falls in blood pressure were observed as frequently in injections below the second lumbar vertebra as in those injected above that level.

Adequacy of anæsthesia The anæsthesia was considered adequate throughout the operation in 110 cases (91.6 per cent). No supplementary anæsthesia was used in this group. The duration of operation of these 110 cases was as follows: 58 cases were under 1 hour, 37 cases were between 1 and 2 hours, 15 cases were between 2 and 3 hours. The longest operation was of 3 hours' duration. The actual duration of anæsthesia beyond the operative time was only rarely noted. We have records of anæsthesia lasting 4 and 6 hours.

The spinal anæsthesia had to be supplemented in 4 cases (3.3 per cent)—1 in the first hour, and 3 in the second hour.

The anæsthesia was entirely unsatisfactory in 6 cases (5 per cent). In 3 of these, we know that the technique of injection was faulty.

These figures compare very favorably with statistics we have recently compiled in an analysis of 497 instances of spinal anæsthesia in which neocaine was used as the spinal anæsthetic agent. In that series, in 65.6 per cent the anæsthesia was adequate, in 32.8 per cent it had to be supplemented, and in 1.6 per cent it was unsatisfactory.

There were 17 patients who complained of varying degrees of discomfort, not severe enough to require a supplementary anæsthesia, but in whom the muscular relaxation was good. In these cases there was a predominating anterior root block with little effect on the posterior roots. Jones tries to avoid this by turning his patients directly on the face for about 5 or 10 minutes before they are placed in the dorsal position. This is particularly necessary, he claims, where nupercaine solutions of a specific gravity less than that of the cerebrospinal fluid are used.

Untoward reactions Untoward reactions on the operating table were noted as follows: vomiting in 4 cases, respiratory failure (with recovery) in 1 case, signs and symptoms of shock, in 10 cases. As noted elsewhere (1), the latter occurred for the most part, in patients in advanced years who showed evidences of arteriosclerosis and myocardial disease, or in those cases of cachexia or intoxication from some debilitating disease.

General condition of the patient before operation A large variety of medical complications was found in the group of patients under consideration. The most outstanding are shown in Table I.

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responsive. Sedatives were of no avail. After 2 hours of struggling, he quieted down. His temperature at this time was 109.4 degrees. He was now stuporous with very rapid respirations. The pulse was rapid but of good quality. Continuous spongings brought his temperature down to 106 degrees. About 7 hours after the onset of his seizure, the quality of the pulse became poor. The temperature at this time was 107.2 degrees. He received stimulation but died 2 hours later, about 14 hours after operation.

Postmortem examination showed hæmorrhagic bronchopneumonia of all lobes of the lungs, acute congestion of all the viscera, a persistent thymus, subendocardial hæmorrhages, chronic valvular disease of the mitral valve, rheumatic endocardial lesion of the left auricle. Gross examination of the brain showed no abnormalities. Microscopic sections of the cortex showed thickening with infiltration of the meninges with leucocytic elements, chiefly polymorphonuclears. Sections of the hypothalamus showed a similar exudate with some evidence of early organization. The adjacent parenchyma showed perivascular infiltration with mononuclear and polynuclear elements and also some extravasated blood. Diagnosis: meningo-encephalitis.

The interpretation of these lesions of the brain is not clear. Dr J. H. Globus, neuro-pathologist at the Mount Sinai Hospital, thinks it unlikely that lesions of this nature could have arisen in the short postoperative course and possibly a cerebral lesion existed before operation.

SUMMARY

1. Nupercaine is a quinoline derivative which may be boiled, is decomposed by alkali, is ten times as anæsthetic as cocaine and about twenty times as anæsthetic as procaine, and is rapidly detoxicated by the body.

2. Five deaths taken from the literature and one unpublished fatality are reported following the use of nupercaine spinal anæsthesia.

3. A review of the literature shows, in general, a satisfactory anæsthesia of long duration, from two to six times that of procaine.

4. This is a report of the use of nupercaine in spinal anæsthesia in 120 cases.

5. The dose recommended is 10 milligrams—2 cubic centimeters of 1:200 solution.

6. Blood pressure fell in about the same number of cases as with procaine (78 per cent of this series). These falls in blood pressure are most marked in patients with a previous hypertension and minimal in those with a previous hypotension.

7. The anæsthesia was adequate in 110 cases (91.6 per cent), unsatisfactory in 6 cases (5 per cent), and had to be supplemented in 4 cases (3.4 per cent).

8. The anæsthesia was of long duration, occasionally lasting 4 to 6 hours.

9. Pronounced reactions on the operating table occurred, for the most part, in patients in ad-

vanced years who showed evidences of arteriosclerosis and myocardial disease, or in those cases of cachexia or intoxication from some debilitating disease.

10. Signs of meningeal irritation are more frequent with nupercaine than with procaine.

11. Signs of cerebral irritation and thermal reactions are occasionally noted after operation.

12. There was a high incidence of postoperative pneumonia, 8 per cent.

13. One fatality is reported in which the spinal anæsthesia was a contributory cause of death.

CONCLUSION

Nupercaine is a good anæsthetic agent for spinal anæsthesia, and is especially indicated in operations of long duration.

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TABLE I

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Nature of operation Types of operation

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 Gynec l gr l
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5 Thermal reactions were noted in 6 cases. The exact mechanism of these reactions is difficult to explain. In 1 case to be described the hyperpyrexia was extreme reaching 109.4 degrees. Vascular complications. In a previous paper () it is noted that after a spinal anesthesia patient with hypertension may develop suppression of urine as a result of marked drops in blood pressure when not overcome. The following is a brief report of a case presenting another complication secondary hemorrhage attributable to a marked fall in blood pressure.

A m n 63 yrs f g th t scl be ty and mphysem was dmitt d t th h p al th l rpe, red bl cur t sc tal h rai Op t u w s f rmed and p ane pinal x th a. Th pre p t e blood p ssur as 146-80. Th mm diate drop 1 pr u w so great th t l d not be re del. Aff that t se to th h h t l e f 80-60. Th p t e f l d was bloodless t sangl ssel being lig ted. Six h afte p t th bl d p w 0-00 t wh h time th dr ssings w blood tain d l d l ped pulm ry ced m and died the seco d day after op t. At p tm t m h atom t th p t ut th scrotum and th right flank was f und d to ung t d b anch f th n n t epg tne rry. In addit th was cut p rul t b achutis pulmo nary ced m d t lectass.

Complications The following are complications which we feel are in some degree attributable to the spinal anesthesia.

1 Headache fasting from 1 to 5 days was noted in 19 cases (15 per cent).

2 Signs of meningeal irritation in the form of rigidity of the neck and a positive Kernig sign were found occasionally—the former in 12 cases and the latter in 6 cases.

We have no accurate record of the number of cases in our former series of neocaine spinal anesthetics showing these subjective and objective signs of meningeal irritation headache rigidity of the neck and Kernig sign but it is our impression that such manifestations were not as frequent with neocaine. At a recent meeting of the American Society for Regional Anesthesia in February 1931 McLellan reported one headache in 215 cases (0.4 per cent) while Weinstein reported 31 headaches in 43 cases of spinal anesthesia (72 per cent). Equally contradictory reports are found throughout the literature.

3 Peripheral nerve palsies were noted in 2 cases—in both cases being an involvement of the sixth abducent nerve.

4 In 5 cases there were signs of cerebral irritation. Some of these patients had varying degrees of disorientation and mental excitability. In 1 case which will be described in detail below the patient had delirium and convulsions.

Pulmonary complication In the paper referred to we noted a relatively high incidence of postoperative pneumonias (4.2 per cent). In this series there was a still higher incidence 10 cases (8 per cent). Spinal anesthesia does not prevent postoperative pulmonary complications. After operations on the upper abdomen particularly patients are liable to these complications whatever the form of anesthesia.

Deaths The following is the report of a case in which the spinal anesthesia was probably a contributory cause of death.

Th p t t was y ung m f 9 yrs dmitt d t th ho p al th history f bd minal pain na sea muti g f and hally se at f 7 h m. H had h d anal track 3 m th b f f u m th t f admiss h h d had f and; int pains said by doct t b h m t f Physical ex m n t sh wed w l d l p d b y ac tely li th t mp t f d g Signs f acut ppe dictis p esent, l d t e t sophary gitis. Ther was l u d t m r m t th dia per In w f th ac t sopharyngitis and th h umati manifestatio spin l th w a g mulligrams f p e cau being sed An t phi gmo ppe dictis was f d d th pp dux rem ed Th anr thesia sat f t r y d th t d g n d ing th per t. The pre-op ratu blood p ssur was 6-80 d pp g t 00-65 s m n t d nising to 0-80 by th d f th p rat o Th p t cent d t was t rly satisf tory until 5 1/2 hours after p t m eq ng se al perso t h l d h m in bed H ned t t sly b t was consci and un

with the common bile duct by fibrous connective tissue, or the common bile duct runs in a deep channel or through a tunnel made completely of pancreatic tissue. In a study of 58 cases, von Burger found that in 55 the common bile duct passed through pancreatic tissue for a length of from 0.8 to 4.5 centimeters and that a layer of 0.2 to 2 centimeters of pancreatic tissue covered the common bile duct. These anatomic features make evident why a carcinoma of the head of the pancreas or marked inflammation of the pancreas will produce progressively increasing obstruction of the pancreatic portion of the common bile duct.

It is a fair assumption, we believe, that if a patient is jaundiced and there is dilatation of the extrahepatic passages and an indurated irregular tumor is palpable in the head of the pancreas, the lesion is probably carcinomatous. On the other hand, the incidence of pancreatitis as a possible cause of this obstruction forces the surgeon to be guarded in prognosis. The patient's progress over a period of time indicates the type of lesion which is producing the obstruction. The risk of removal of a portion of pancreas for microscopic examination at the time of operation on these deeply jaundiced patients, in our opinion, is not warranted.

SYMPTOMS

Carcinoma of the head of the pancreas occurs in later life. In this series, only 2 patients with carcinoma of the head of the pancreas were less than 40 years of age. One of these was a man of 34 years and the other a woman of 39 years. In 8 other cases in this series of patients who were younger than 40 years, the obstruction was due to an inflammatory process in the head of the pancreas. These obstructive lesions affected men twice as often as women.

Probably one of the most outstanding points in the differential diagnosis of tumors in the head of the pancreas has been the infrequency with which jaundice is associated with pain. In 99 of the 113 cases, the jaundice had painless onset. This, however, must not be taken to be a criterion of pancreatic obstruction of the common bile duct, in our experience the presence or absence of pain, with or without chills and fever, has depended more on the degree of the obstruction and the amount of infection in the biliary passages than on the factors which produced the obstruction, whether these factors were stones, strictures, or tumors of the head of the pancreas. This is exceedingly important, for by the same token that a patient with a stone in the common bile duct may have had painless jaundice, likewise a

patient with pancreatic obstruction of the common bile duct may have had biliary colic either preceding the onset of the jaundice, such as occurred in 14 of our cases, or non-colic-like pain, such as occurred in 58 cases before or after onset of jaundice.

In a study, made in 1919, by Mussey, of 100 cases of carcinoma of the pancreas in which jaundice did not occur, pain was the predominating symptom. In cases of carcinoma of the head of the pancreas producing jaundice, pain may occur in the course of progress of the lesion. The correlation of the various types of pain with the observations at operation or at necropsy seemed to indicate that colic-like pain was associated with involvement of the ducts, that pain in the back was associated with involvement of the body and tail of the pancreas, and that pain in the left upper quadrant of the abdomen not infrequently occurred with diffuse, subacute pancreatitis.

Variations in the degree of jaundice, and the presence or absence of bile in the duodenal content, have afforded fairly accurate methods of determining whether the jaundice was intrahepatic, or whether it was due to obstructing lesions of the pancreatic portion of the duct. If a patient has painless jaundice and bile is obtained in the duodenal content by non-surgical duodenal drainage, by the Lyon tube, the jaundice is most likely to be of intrahepatic cause. When obstructing lesions in the head of the pancreas produce jaundice little bile is obtained in the duodenal content. Similarly, variations in the degree of jaundice, as well as variations in the amount of bile in the blood, as indicated by the van den Bergh test, have aided in differentiating the various types of biliary obstruction.

All distended gall bladders are not palpable through the abdominal wall. In a study by Weir and Partch of 275 cases in which operation was performed at The Mayo Clinic for lesions of the pancreas producing obstructive jaundice, a palpable gall bladder was noted in approximately 60 per cent of the cases.

Rapid loss of weight in cases of carcinoma of the head of the pancreas is a striking feature. In 54 of our cases the patients lost from 15 to 65 pounds (6.8 to 29.5 kilograms). As might be expected, gastro-intestinal symptoms, dyspepsia, anorexia, various types of indigestion, and in some cases vomiting, particularly in cases in which the lesion is advanced and produces extra-gastric or extraduodenal obstruction, are not uncommon. If duodenal or gastric obstruction occurs, and the condition of the patient permits,

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JAUNDICE CAUSED BY PANCREATIC LESIONS

WALTMAN WALTERS M.D.

D. van der Sijde et al.

A D

ERNST A. DEHNE M.D.

Fil S ger The M Funda Roches er M rse

WE have distinguished three types of jaundice hæmolytic intrahepatic and that due to obstruction of the extrahepatic bile ducts. In the last group jaundice may be due to obstructing stones to strictures or to tumors of the head of the pancreas which may be either malignant or inflammatory. In obstruction of the pancreatic portion of the common bile duct anastomosis between the gall bladder or common bile duct on the one hand and the stomach or duodenum on the other suffices to relieve the obstruction and to re-establish the continuity of the biliary and intestinal tracts. This operative procedure is encouraged by the marked distention of the gall bladder and the bile passages in such cases.

We are presenting a study of 113 cases in which lesions of the pancreas have produced obstruction of the bile ducts sufficient to produce jaundice. The patients were all operated on at The Mayo Clinic cholecystenterostomy was performed. Fifteen per cent of the patients who recovered from the operation lived longer than 5 years after operation. Of these 7 patients are living 13 years 19 years and 28 years. The supposition is that in the cases in this group in which the patients lived longer than 5 years the obstructing pancreatic lesion was inflammatory. Supporting this are the microscopic observations in a group of 25 cases in which tumors in the head of the pancreas produced obstructive jaundice in 4 of these the pancreatic lesion was found to be inflammatory and in the remaining 21 malignant.

The inflammatory type of obstruction has been called a part of a panbiliary infection by Hartman. The obstruction may be localized in the head of the pancreas or in the walls of the biliary passages.

In a study of 1027 cases in which operation for disease of the biliary tract was performed at The Mayo Clinic in 1912 Hartman found that in 60 per cent of the cases the disease was due to inflammatory lesions without biliary calculi. The routes of infection leading to pancreatitis in most instances may be through the lymphatic channels from the gall bladder or duodenum or infection may be haematogenous. If the pancreatitis is mild and does not cause marked obstruction of the common bile duct cholecystectomy and temporary drainage of the common bile duct usually suffice to relieve the pancreatitis. Schmieden instituted drainage of the common bile duct in 139 of 318 cases. He effected anastomoses of the biliary and intestinal tracts in 50 cases, made incisions of the pancreatic capsule in 106 and incisions of the glandular tissue in 27. He reported permanent recovery in 230 of these cases.

THE RELATION OF THE COMMON BILE DUCT TO THE PANCREAS

We shall not describe in detail the blood supply to the pancreas or its lymphatic structures yet I think emphasis should be placed on the probable connect on between the lymphatic structures of the gall bladder and of the pancreas and on that between the duodenum and the pancreas. Bartels stated that anastomosis can be demonstrated between these communicating lymphatics by injection either of one system or of the other.

The relation of the lower end of the common bile duct and the pancreas was accurately studied by Helly who stated that either the lower end of the common bile duct lies in a niche of pancreatic tissue and that this niche is changed to a tunnel by the wall of the duodenum which is connected

that narrowing or partial occlusion of the stoma of the anastomosis, such as occurred in the case he reported, was the determining factor

Our experience gives further confirmation to this statement. In 3 of the cases in which necropsy was performed, cholangitis and formation of abscesses had occurred. In all 3 cases, cholecystenterostomy had inadequately relieved the obstruction. In 2 cases, the cystic duct was invaded and obstructed by the tumor, and in 1 case the tumor of the cystic duct with the common bile duct was so low that the cystic duct was compressed and obstructed by the tumor at the head of the pancreas. Besides, one of our cases illustrated very well that cholecystenterostomy without obstruction is well able to take care of an infection of the biliary tract. One man had recurrence of jaundice, associated with chills and fever, 6 months after operation. This man returned to the clinic 6 years later, for treatment of chronic seminal vesiculitis, he had not had any gastro-intestinal trouble for many years.

The risk of operation in these cases is dependent on the condition of the patient, particularly on the duration of jaundice. The results of operations performed on the gall bladder and biliary passages at The Mayo Clinic in 1929 were reviewed by Judd and Walters, they found that in that year cholecystenterostomy had been performed in 10 cases for tumors in the head of the pancreas, without a death. In 1930 a similar number was performed with 1 death and that from bronchopneumonia. In this group, in more than half of the cases, jaundice was so deep at the time of operation that cholecystenterostomy was performed in two stages.

NATURE OF PATHOLOGICAL LESIONS AT THE HEAD OF THE PANCREAS PRODUCING JAUNDICE

Postmortem examinations in 26 cases in which there were tumors in the head of the pancreas which had produced obstructive jaundice, have shown that in 21 of the cases, the lesion was malignant adenocarcinoma, scirrhus carcinoma, or mucus-cell carcinoma. Some of these 26 patients were in such poor condition that operation could not be performed. In 5 cases the obstruction was due to inflammatory lesions. Of the 21 carcinomata, 14 originated from the head of the pancreas, 4 from the lower end of the common bile duct, and 3 from the ampulla. Metastasis to the regional lymph nodes or to the liver was present in less than half of the cases.

Some cases in this series called attention to the fact that distention of the bile ducts and of the gall bladder, accompanied by a marked degree of

biliary cirrhosis, may be found after a very short period of jaundice. A possible explanation for this was seen in a case in which gastro-enterostomy was done for duodenal obstruction due to carcinoma at the head of the pancreas. Jaundice had not occurred in this case. At operation marked distention of the gall bladder and bile ducts was noticed which may have existed for a considerable length of time. Seventeen days after the operation, jaundice developed. This was relieved by cholecystenterostomy. After recovery from the operation, the patient died of general carcinomatosis.

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we have not hesitated to perform gastroenterostomy

SURGICAL TREATMENT OF OBSTRUCTIVE JAUNDICE DUE TO PANCREATIC LESIONS

Much has been written before of the value of cholecystectomy and drainage of the biliary passages if a mild degree of pancreatitis has existed secondary to definite evidence of cholecystitis. The cases which we are studying and are presenting are those in which little if any evidence of infection is present in the walls of the gall bladder or the common bile duct in which distention of all of the extrahepatic ducts is marked and in which evident thickening of the head of the pancreas seems to indicate the site of obstruction. In the cases cholecystenterostomy has seemed indicated. The benefits of operation in such cases have not only been relief of the jaundice and the troublesome itching of which many of these patients complain so bitterly, but it has been the means of enabling thorough and certain exploration of the biliary passages to eliminate the possibility of the presence of removable obstruction such as stones.

The risk of cholecystenterostomy (3) has been due to two factors, the tendency to bleed as the result of severe jaundice and renal and hepatic insufficiency subsequent to operation. It has been our custom to prepare for operation all patients with jaundice by a method which Walters described in 1921. The patients receive three daily intravenous injections of 5 cubic centimeters of a 10 per cent solution of calcium chloride. This may be diluted by adding 100 cubic centimeters of physiologic solution of sodium chloride. They are also given a diet high in carbohydrates which often is supplemented by intravenous injection of glucose 10 per cent in physiologic solution of sodium chloride.

Whether the stomach or the duodenum is chosen as the site for anastomosis with the distended gall bladder is dependent on the accessibility of the structures and the ease of their approximation without tension. One should not hesitate to perform anastomosis of the gall bladder and the stomach in any of these cases for apparently the presence of bile in the stomach is not a source of permanent discomfort.

The operation may be done in one stage or in two stages; the anastomosis may be made by suture or by use of a Murphy button. Decision as to whether the anastomosis should be done in one stage or whether cholecystostomy should be performed 12 or 14 days before the anastomosis depends largely on the patient's condition. If

jaundice is not too deep and the patient's general condition is satisfactory there is no reason why cholecystenterostomy in one stage should not be carried out. In doing this operation in one stage one must be certain that there is no bleeding from the edges of the anastomosis and in this respect the use of a hemostatic inverting suture of the buttonhole locking type serves admirably. If the jaundice is deep and the patient's condition is less satisfactory than is desirable the jaundice can be diminished by preliminary cholecystostomy before the anastomosis is made. This not only decreases the jaundice and the tendency to bleed but also lessens the chance of precipitating hepatic and renal insufficiency. Walters, Greene and Fredrickson have demonstrated that following cholecystostomy for relief of obstruction of the pancreatic portion of the common bile duct, a tremendous amount of fluid as well as of sodium chloride is discharged through the biliary tract and is lost from the body. If this loss is allowed to continue in many instances the patient will succumb from dehydration or toxæmia in a comparatively short time. For this reason the anastomosis between the gall bladder and the stomach or duodenum should be made approximately on the eleventh or fourteenth day following cholecystostomy to prevent the occurrence of this dehydration toxæmia.

RESULTS OF OPERATION

Fifteen per cent of the patients in this series have lived more than 5 years; 25 per cent have lived longer than 3 years; one patient is living and still 13 years after operation; another died 13 years after operation from intercurrent disease and died 8 and 9 years respectively following operation. Twenty-four of the 33 patients are alive at the time they were traced. In 5 cases duodenal involvement or obstruction occurred. Four patients gained considerable weight after operation.

The question has arisen as to whether cholecystenterostomy with the consequent loss of pinenteric action between the biliary and gastro-intestinal tracts might not be followed by ascending infection of the intrahepatic biliary passages. Experimental work by G. Teed and Poppen and by Beauregard is that such infection following cholecystenterostomy performed on animals usually occurs. However, clinical experience in man has not been corroborated by these observations. After study of the literature E. W. Wangensteen stated that the complication of cholangitis following cholecystenterostomy has but infrequently been observed and

reddened abrasion of the medial portion of the left labium majus. The Wassermann reaction was negative. At operation a partial gastrectomy with gastrojejunostomy was done. The patient made an uneventful convalescence and was discharged July 18, 1928, improved. The pathological examination of the tissue removed revealed an adenocarcinoma of the stomach with metastases to the regional lymph nodes.

At the present admission there was no evidence of gastrointestinal disturbance. The physical examination, except for the vulva and extremities, was essentially negative. No abdominal masses were felt. The lower extremities showed rather marked varicosities. Examination of the external genitalia revealed a relaxed outlet from which there was no discharge. In the midportion of the inner aspect of the left labium majus there was an irregular elliptical shaped area measuring about 3 by 2.5 centimeters in diameter. Superficially this was clearly demarcated and slightly raised above the level of the surrounding skin. Throughout, there were numerous small, shallow ulcerated areas which appeared moist. To palpation the tumor was slightly indurated. It was not tender to pressure. There were no palpable inguinal lymph nodes. The laboratory findings were within normal limits. A clinical diagnosis of basal cell carcinoma of the vulva was made.

On November 4, 1930, using local anesthesia, novocain infiltration, the tumor was excised and the resulting wound approximated without difficulty. No postoperative complications occurred and the patient was discharged November 8, 1930. At a follow-up examination on January 7, 1931, the wound was found to be well healed. The patient was entirely relieved of her symptoms. At a subsequent examination done May 1, 1931, there was found no evidence of recurrence. The patient's condition was satisfactory.

Pathologic study. *Gross.* The specimen consisted of an elliptical shaped piece of tissue which measured 3 by 2.5 by 0.6 centimeters. It was covered on the outer surface by epithelium, the borders of which were of a light brown color. The central portion, which was slightly elevated, presented a lighter colored area measuring about 2 centimeters in its greatest diameter. In this portion of the tissue there were several shallow ulcerated areas of varying size, the largest of which measured 1.5 centimeters and the

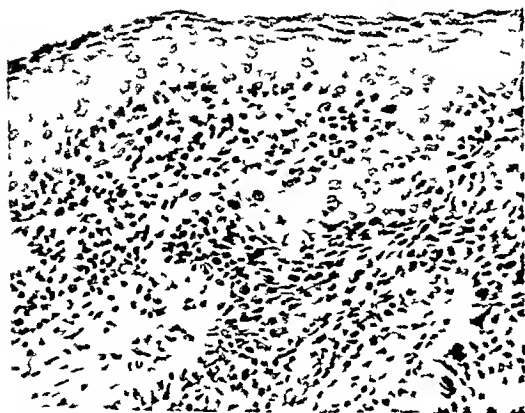


Fig 2 Photomicrograph showing direct connection between the tumor cells and the rete pegs of the overlying skin. Hematoxylin eosin $\times 220$.



Fig 1 Photograph of surgical specimen showing tumor and surrounding skin. Throughout the tumor surface the ulcerated areas are clearly shown.

smallest 0.1 centimeter in greatest diameters. The edges of these ulcerated areas were slightly elevated, firm, sharply defined, and irregular in contour. The bases were smooth, shallow, and pink in appearance. The inner surface of the specimen was covered by normal appearing fibrous and adipose tissue. On section the tissue offered little resistance. The cut surface presented a gray appearance throughout which lighter gray areas were seen which extended downward a short distance from the thickened epithelium and the ulcer beds, as irregular nodules and fingerlike projections. The ulcerated areas appeared to involve only the epithelial surface.

Microscopic. The material was fixed in a neutral solution of formaldehyde (4 per cent). Some of the preparations were stained with hematoxylin eosin. Others were stained according to Mallory's technique for connective tissue and McCallum's and Ziehl-Neelsen's methods for bacteria. The microscopic preparations showed one surface to be partially covered by stratified squamous epithelium. Throughout were seen several ulcerated areas limited by

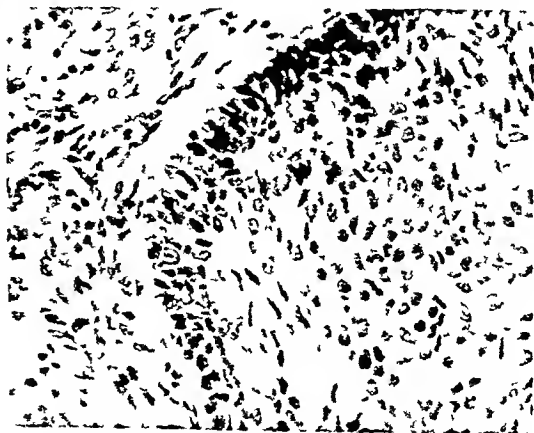


Fig 3 Photomicrograph showing the smaller peripheral cells and the larger central cells. The hyaline-like connective tissue immediately surrounding the tumor is not shown as well as in the microscopic preparation. A few small round cells are seen in the surrounding connective tissue. Hematoxylin eosin $\times 335$.

BASAL CELL CARCINOMA OF THE VULVA¹

LOUIE N CLAIRBORN M D A D HUBERT B HOLSINGER M D A W HAVE CO NEXT CUT

BASAL cell carcinoma may be defined as a special type of epidermoid tumor which has its origin in the basal layer of the epidermis the sweat or sebaceous glands or the hair follicles. It has a characteristic clinical course and structurally has a specific gross and microscopic appearance. Since Krompecher's monograph in 1903 this tumor has been generally recognized as a definite pathological entity.

Typically basal cell carcinoma adopts as its site of election the face. It occurs chiefly on the cheeks, nose or outer or inner canthi of the eyes. In a series of 268 cases reported by Broders 96 per cent of the tumors were found above the clavicles. Schreiner, Simpson and Mueller in a group of 59 patients reported by them stated that about 90 per cent of the lesions of their patients appeared on the face, all notably above a line drawn on a level with the upper lip.

In reviewing the literature concerning tumor of the vulva one is immediately confronted with the loose use of terminology which makes for not a little confusion and misunderstanding. Terms referring to the existing confusion say, a good illustration of this is to be found in the peculiar chronic infective enlargement of the vulva to which the terms elephantiasis pseudo elephantiasis, esthomenic rodent ulcer, lupus granuloma and syphiloma of the vulva have been applied. Rather numerous cases have been reported under the title of rodent ulcer of the vulva, but on careful analysis appear to be entirely chronic inflammatory lesions to which the author has attributed various etiological factors, i.e. syphilis, gonorrhea and tuberculosis. The cases reported as rodent ulcers by F. Jess A. Rieck, O. Orsini and L. Machado and M. Maffett are apparently of this nature.

We have been able to find only instances in which basal cell carcinoma of the vulva has been described in the literature. In 1966 N. Ternes reported the case of a 53 year old woman who had had recurrent erysipelas and furunculosis of the vulva. At the time of her amputation she had multiple small nodules over the labia majora, the previous infection having subsided. None of these tumors was ulcerated. There was some oedema of the clitoris, labium minora and inner aspects of the thigh but no evidence of tumorous involvement in those regions. Laboratory studies including examination of the blood and

urine showed nothing unusual. The Wassermann reaction was negative. A biopsy from one of the nodules presented on microscopic examination a typical picture of basal cell carcinoma. The patient received radium treatment twice during the course of a month with no apparent change in the gross pathological picture. She then went to another clinic and died 4 months later from congestive heart failure.

Leinheb in 1927 described the case of a 68 year old woman who for about a year had had an intense itching and prickling sensation of the vulva. She had had no previous treatment. On examination both labia majora and minora showed some thickening, with areas of ulceration and leucoplakia. The inguinal nodes were enlarged firm but not tender. The Wassermann reaction was negative. A biopsy was done and subsequently a vulvectomy with dissection of the inguinal nodes. From the microscopic studies a diagnosis of basal cell carcinoma was made. The inguinal nodes showed no evidence of neoplastic invasion. Seven days following the second operation the patient died from bronchopneumonia.

We wish to present a case of basal cell carcinoma of the vulva which we have had the opportunity of studying. For this privilege we are thanks to Dr F W Roberts of New Haven Connecticut.

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A NEW METHOD OF TREATING BREAST ABSCESES

JOHN E. HOBBS, M.D., St. LOUIS, MISSOURI

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IN presenting this paper it is not my purpose to review the different methods of treating breast abscesses. I wish to illustrate and describe briefly a method which has proved to be very satisfactory.

It is not necessary to enter into a discussion as to the etiology and prophylaxis of breast abscesses. Everyone is aware that prevention is important and practically all cases of breast abscess can be prevented, but due to the lack of knowledge or negligence of the attending physician or more often the mother, breast abscesses still occur too frequently during the lactation period.

The same principles are maintained in treating breast abscesses as in treating suppuration elsewhere in the body, that is, incision and adequate drainage, rest, proper elimination, and symptomatic treatment. The optimum time for incision occurs when definite fluctuation appears. Delay may mean extension and undermining of tissue with destruction of most of the lobules. In order to establish proper drainage by the usual method, it is necessary to make a large incision and oftentimes counter drainage is necessary. If it were possible to establish proper drainage with a small incision in the breast tissue, the ugly scarring could be avoided and normal breast tissue saved. DeLee states, "In opening abscesses some respect should be paid to the appearance of the breast."

Another important factor in treating breast abscesses is the question of dressings. If one has to pack open an abscess cavity with rubber tissue, gauze, or whatever seems suitable to use, the pack has to be renewed daily, causing severe pain unless an anæsthetic is used and one does not like to anæsthetize his patient for a change of dressings. On the other hand if the patient is not narcotized one cannot pack the cavity thoroughly.

The third point for consideration is a satisfactory support for the breast, that is, one which will lift the breast and give moderate compression and maintain that support from one dressing until the next.

It seems logical, therefore, that if one can overcome or minimize these three obstacles, one has made some progress in satisfactorily treating breast abscesses. The method about to be described aims to eliminate these difficulties, and experience has verified its practicability.

Adequate drainage through a very small incision can be established as follows. Under nitrous oxide anæsthesia, a stab wound is made large enough to accommodate a rubber tube, $\frac{1}{2}$ inch in diameter. The incision should be made at the lower or outer margin of the abscess and carried radially from the nipple, staying outside the areola in order not to cut any of the lactiferous ducts. The finger is inserted into the cavity and all septa between the pus pockets broken down. The rubber tube, $\frac{1}{2}$ inch in diameter, is then inserted into the cavity and fixed to the skin with a silk or catgut suture. A Dakin's tube is then inserted through the rubber tubing, or, if the cavity is large enough, two Dakin's tubes may be inserted (Fig. 1). The cavity may be thoroughly washed out with hypochlorite or sodium, a painless procedure. There can be no distention of the cavity with fluid for the large tube acts as a reflux. Carrel and Dakin introduced hypochlorite

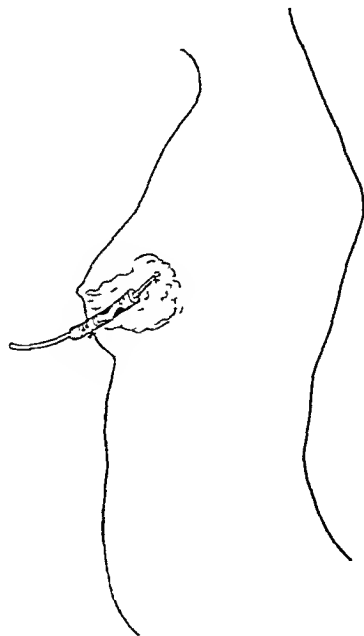


Fig. 1. Drawing showing a half inch rubber drain inserted into the abscess cavity and anchored to the skin with a silk or catgut suture. A Dakin's tube is inserted through the rubber drain into the abscess cavity.

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Basal cell carcinoma of the vulva is exceedingly rare but probably more frequent than the specific literature would lead one to believe. In 1903 Trompeter described a case of basal cell carcinoma of the vagina occurring in a woman past the menopause. Basal cell carcinoma in general occurs in patients past middle life. In the 2 cases reviewed and our own case the ages were 53, 68 and 69 years respectively. In the case described by V. Leigheb as well as ours pruritus was the predominant symptom. In the case of N. Temesváry the preceding conditions were recurring attacks of erysipelas and furunculosis. Chronic irritation probably is as significant an etiological factor in this location as elsewhere. Long continued irritation according to H. Dutrick also acts as an important etiological factor in the formation of squamous cell carcinoma of the vulva. Pruritus is the most common symptom in this condition as well as in basal cell carcinoma.

N. Temesváry in the treatment of his case employed radium but was unable to complete the

course of treatment because the patient moved to another clinic hence he could not determine the value of this type of therapy. A vulvectomy with dissection of the inguinal nodes is as done on the case described by V. Leigheb. There seems to be no justification for such a radical procedure. This case died a year later from bronchopneumonia. In our case a local excision was done and it date the patient has shown no evidence of recurrence.

CONCLUSIONS

1. Basal cell carcinoma of the vulva though rare does occur.
2. The clinical course and pathological picture are comparable to basal cell carcinoma of elsewhere and the treatment should be the same.

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and do not elevate the breast. Adhesive strapping gives good support and compression if long and wide strips are used, but adhesive tape is painful to remove, and many skins are sensitive to it, and a marked local reaction is produced. A satisfactory binder can be made of gauze 16 inches wide and 5 yards long, folded so that it is 4 inches wide. This can be rolled, wrapped in a cloth, autoclaved, and kept sterile. With the gauze roll, the mammary gland can be lifted upward by carrying the bandage up over the opposite shoulder (Fig. 2), and firm pressure can be secured by carrying the bandage around the chest wall (Fig. 3). These binders do not slip and in addition they serve as a protective dressing. When support is no longer needed and the drainage is scant, a small dressing applied with narrow strips of adhesive tape is substituted.

SUMMARY

1 The occurrence of breast abscesses can be prevented in great part by suitable prophylactic measures, but due to neglect by the attending physician or mother, breast abscesses still occur frequently during the lactation period.

2 It is important to establish proper drainage with minimum scarring of the breast. This can

be done by making a stab wound large enough to accommodate a rubber tube $\frac{1}{2}$ inch in diameter, which is made secure by suturing to the skin. Other drains and counter drainage will be unnecessary. A Dakin tube is inserted through the drainage tube and the cavity is irrigated with hypochlorite of sodium, which is a disinfectant, destroyer of necrotic material, stimulator of granulation tissue, and a deodorant. It does not harm healthy tissue.

3 Vaseline gauze is a dressing which can be removed and applied without pain to the patient. It protects the skin from the irritating and macerating effect of the discharge. It is imperative that this or some other oily dressing be used when the cavity is irrigated with hypochlorite of sodium.

4 A gauze roll makes an excellent binder, for it gives support, compression, and serves as a protective dressing.

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Fig. 2. A ph tog ph f p t t sh ang th fir t
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Fig. 3. Ph tog ph h ang th b d g mply t
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of sodium during the World War as a means of treating infected wounds. The Carrel Dakin method of treating empyema was adopted by the Empyema Commission and has been of inestimable value. To my knowledge Dakin's solution has never been used in treating breast abscesses at least. I have been unable to find it described in the literature. Dakin's solution is not only a disinfectant but destroys certain unorganized fibrous deposits, stimulates clean granulation tissue and is a deodorant. It is important to introduce some solution which will destroy bacteria quickly, remove necrotic material and not injure healthy tissue. One should incise the abscess as soon as fluctuation occurs and disinfect the cavity thereby eliminating or minimizing the possibility of autoinfection and multiple abscess formation. Bacterial counts before and after the use of Dakin's solution give conclusive evidence of its bactericidal properties. The bactericidal properties of Dakin's solution have been affirmed many times in treating empyema cases. Within 24 hours the discharge changes from a purulent material to a seropurulent exudate. It stimulates healthy edge granulation tissue. The tube can be left in until the wound begins to granulate around it. The Dakin tubes can be bought used through the dressing and the cavity irrigated without disturbing the dressing. If the patient is a hospital case, one can irrigate the cavity twice a day if ambulatory, once daily if he is sufficient. As soon as the cavity becomes collapsed and clean, the irrigations may be stopped. It is easy to measure the amount of fluid the cavity will hold, which is a good index as to the rapidity of the healing process. There is one warn-

ing about using hypochlorite of sodium, namely, it is irritating to the skin. The skin must be protected and the most convenient form of protection is vaseline gauze. (Vaseline gauze is prepared by cutting six inch strips of gauze bandage, placing in a polyethylene container with a large amount of vaseline on top and sterilizing in the autoclave.)

Obviously one cannot insert a drainage tube into a small superficial subareolar abscess. A small gutter or chest drain should be inserted at the time of incision and the cavity irrigated by placing a small piece of Dakin's tubing on the tip of the syringe and inserting into the cavity. Very gentle pressure should be used. Otherwise our operations are usually all that is necessary.

As a dressing, vaseline gauze is excellent for any suppurating wound even though sodium hypochlorite is not used. It protects the skin from the irritating and macerating effect of the discharge, thereby preventing other causes of infection and the patient feels more comfortable. A very great advantage is that it can be removed from the wound without causing any pain and it does not become adherent to the edge of the wound and skin. One can cover the vaseline gauze flats or fluffs.

The question of supportive bandages is of great importance. The requisites of a good binder are first that it must lift the breast so that it must compress the breast against the chest wall, third that it must not be too bulky and make a tourniquet or girdle application from the underarm until the next. Most breast binders become loose

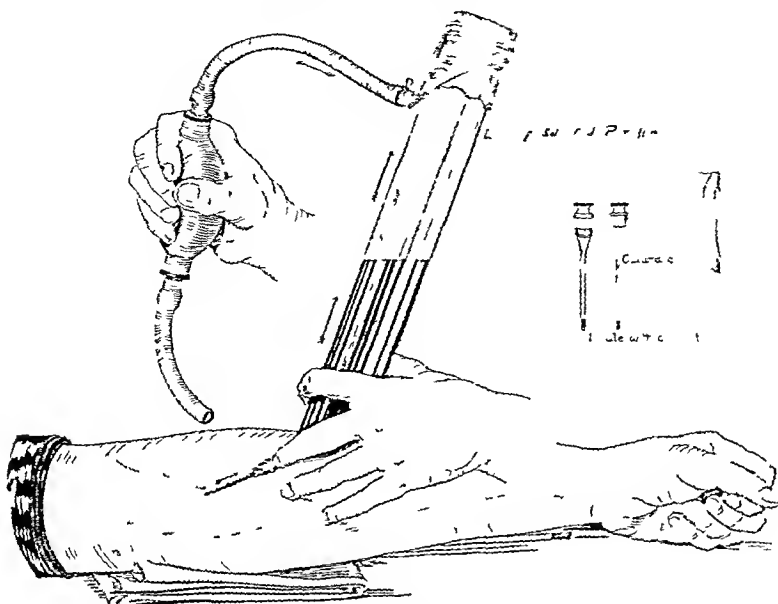


Fig 1 Collecting blood from donor Note manner of holding needle onto tube with middle finger Also note that fourth and fifth fingers rest on forearm of donor to steady needle in vein

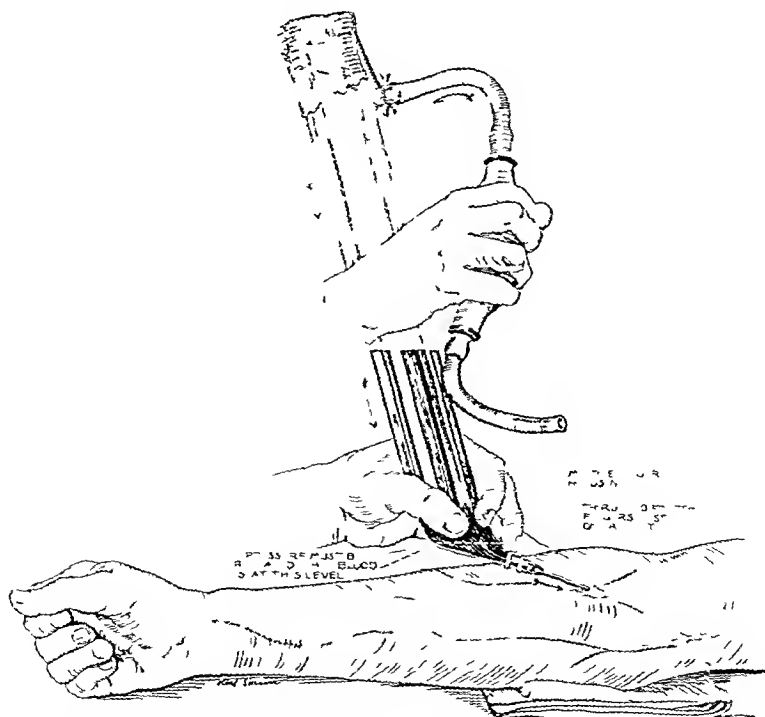


Fig 2 Pressure bulb must be released at point indicated to prevent air embolism

A MODIFICATION OF THE KIMPTON-BROWN METHOD OF WHOLE BLOOD TRANSFUSION

L. ROYBROOKS BS MD FACS S v FRA C C CALIF R A
F m h D p me t IS ry S nf d U M d al S hool

THE practical value of the following modification of the Kimpton-Brown method of whole blood transfusion warrants its publication.

Apparatus. Glass tubes of 300 cubic centimeters capacity, special needles with obturators and a rubber pressure suction bulb constitute the apparatus. The tips of the glass tubes are similar to the tips of the large Luer syringes. The needles are Nos. 14 and 16 for donor and recipient respectively and are equipped with obturators which mechanically fill the hub and barrel of the needle similar to obturators of lumbar puncture needles (Fig. 1).

Preparation of apparatus. With the cork stopper removed, the tubes are thoroughly cleaned and dried. A cubic inch of solid paraffin is placed in each tube, the cork inserted in the upper end and tied securely by means of a string which passes over the cork and around the glass tube below the airway (Fig. 2). Several such tubes are prepared in this manner and are placed in the autoclave for sterilization. With gloved hands and a sterile towel the tubes are gently rolled while the paraffin is still liquid, a small amount of paraffin being allowed to escape through the tip and to coat the entire inner surface of the tube. The tubes are then placed with the upper end downward and the excess paraffin is allowed to accumulate and solidify next to the cork above the airway. This will prevent air escaping around the cork when the blood is being injected. The tubes are then wrapped separately in two sterile towels which are held in place by rubber bands and stored away until needed. In rural districts the oven of a cooking stove may be used instead of an autoclave. It is not necessary to sterilize the rubber bulbs.

The needles should be sharpened on a fine emery and oil stone disc 4 1/4 inch in diameter polished by a small hand motor obtainable from a toy hardware store. The hollow ground effect imparted to the needle by these disc stones is of definite advantage in needle gauge. The proper length of the bevel of a needle for intravenous use is one and one-half times the diameter of the needle. The needle should be sharpened by the person who intends to use it and sterilized by lysol or by methods usually used in sterilizing sharp instruments and not by boiling or by the

autoclave as the latter would interfere with the needles holding a sharp edge because of change in the temper of the metal. After sterilization the needles should be thoroughly dried with ether and placed in separate test tubes with a plug of cotton at the bottom which is saturated with liquid petrolatum. Needles thus cared for will not rust and can be prepared and kept for use at any time.

Procedure. A No. 16 needle is inserted into the vein of the recipient and plugged with the proper obturator which because it completely fills the hub and lumen of the needle prevents the loss of blood and equally important the formation of a clot in the needle. A No. 14 needle is attached to a suction bulb and connected to a paraffin coated tube (Fig. 3). This needle with the tube attached is inserted point to point in the skin at the elbow of the donor. With a blood pressure apparatus applied as a tourniquet at an optimum pressure of 30 millimeters of mercury a draw with a vacuum created in the tube by means of the suction bulb 250 cubic centimeters of blood collected in an average time of about 60 seconds. The tourniquet is released and the paraffin tube is disconnected from the donor's needle which is immediately plugged by the proper obturator and left in the vein of the donor.

The suction pressure bulb is reversed. The paraffin tube is connected with the needle in the recipient's vein and the blood is injected as rapidly or as slowly as desired. More than one bulb must be at hand so that in case a failure occurs another can be quickly substituted. If the needle in the patient's vein should happen to get dislodged after the blood has been collected from the donor the blood should be re-injected into the donor's vein until the needle is replaced into the patient's vein. The pressure bulb must be held edge of the bevel to the skin and the blood must be injected to prevent the needle from entering the vein. With a others paraffin coated tube be 250 cubic centimeters more blood collected from the donor and introduced to the recipient. This can be repeated if necessary until the desired amount of blood is transferred. Tubes of blood have been taken from a vein of one donor at one sitting.

If the patient is an infant or has collapsed or a vein is exposed by a skin incision under

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SPREADING PERITONITIS COMPLICATING APPENDICITIS

IN their literal interpretation few terms used by the surgeon vary as much as do general or diffuse peritonitis. These terms are used in an attempt to describe a process of unknown extent which cannot be determined accurately by physical examination or seen at operation. The term "local" is definite in its meaning. "General" or "diffuse" denotes the extension of the process to the entire peritoneum but "spreading" suggests an actively progressing process.

Frequently the diagnosis of a spreading peritonitis is made before operation because of the presence of extreme rigidity of the abdominal muscles. This rigidity is a reflex process running by way of the intercostal and lumbosacral nerves. However, the terminals of these nerves are irritated only when the parietal peritoneum is involved. The peritoneum covering the posterior abdominal wall may be involved without producing rigidity.

Many physicians emphasize the importance of distention as an aid in the diagnosis of

spreading peritonitis but distention invariably occurs late and is therefore of no value in making an early diagnosis. Absence of peristalsis may be a significant factor in making a diagnosis, but in the early stages of a spreading peritonitis there may be intestinal contraction as evidenced by gurgling in segments adjacent to the site of the infection. Localized tenderness is an important early sign but frequently it is interpreted as the result of a lesion in an organ when actually the process has spread to the peritoneum. While rigidity and localized tenderness are the most important signs, in early peritonitis the former may be absent and the latter not marked if the appendix is abnormally located and the infection is spreading retrocæcally or toward the pelvis.

The diagnosis of a spreading peritonitis complicating appendicitis is most frequently made at operation. When a long vertical incision is made it is possible to determine the extent of peritoneal involvement but this method always involves danger to the patient. Dudgeon and Sargent in 1905 used this incision. Long vertical incisions, however, are not always used in operating for appendicitis. Of 3,095 patients operated upon in Philadelphia in 1930, by 338 surgeons, the McBurney, transverse or oblique incisions were used in 37.8 per cent. It is evident that the extent of peritonitis could not be determined by inspection in these cases. Furthermore, in some cases of spreading peritonitis but slight visible pathological changes are evident in the peritoneum.

The diagnosis of peritonitis complicating appendicitis is seldom made before the patient enters the hospital, for example of the 8,216

surgery has the plan of the multistage, or divided operation, proved so valuable, and yet in no field has its utility been so widely debated, as in that dealing with treatment of diseases of the thyroid gland

When the surgical treatment of goiter began to receive special attention, as was the case about 20 years ago, ligation of the superior thyroid arteries became an established and frequently utilized technique. In many clinics a majority of the patients with exophthalmic goiter received preliminary ligations, while certain surgeons refused to perform a thyroidectomy without this preliminary step. The operation was performed not so much as a means of reducing the technical difficulties of the major part of the treatment but rather as a test of operability, and, especially, as a means of improving the patient's general condition, thus reducing the risk incurred on the occasion of the subsequent thyroidectomy. The ligated patient improved as a result of a definite physiological effect produced within the gland itself not, as is sometimes the impression, merely as a result of the rest regimen simultaneously prescribed. Possibly, hundreds of these minor procedures were unnecessarily performed, yet it must also be true that many patients were saved who, without this preliminary step would have succumbed had they been subjected to a primary bilateral resection. In the same era the plan of multistage partial lobectomy was extensively followed. As our knowledge of thyroid physiology and pathology increased and as surgical technique improved, especially after the introduction of iodine in the patient's pre-operative preparation, multistage operations were less frequently performed until they almost disappeared from our operating lists. It became the fashion to place oneself in the position of saying that one never ligated, while, although it was not so universally discarded,

the divided thyroidectomy also lost much of its former popularity, not because of any apparent lack of utility, but because, as if this implied technical simplicity were convincing evidence of our surgical progress, it had become the surgical style not to resort to it.

Desirable as lack of complexity in any surgical procedure may be, the definite value of these multistage operations, including superior pole ligations, should not be lost sight of. At present there seems to be a logical and fortunate swing-back to the occasional use of these procedures, the desirability of which has recently been referred to by Clute, who states that, as the percentage of operations per patient increases, the mortality percentage has decreased. If a hundred primary thyroidectomies are performed by surgeon A, who never resorts to other procedures, with no deaths following, but his one hundred first patient dies, while surgeon B performs one hundred and one thyroidectomies—a few being in stages—and all his patients recover, the question of which operator had the better results and, it may be supposed, exercised the greater judgment, can hardly be open to debate. The problem is the determination of what constitutes *too much* surgery in the individual case.

Although the use of iodine in the pre-operative preparation of the patient has greatly lessened the need for thyroid arterial ligation, the simplicity of the procedure and the startling improvement it almost invariably produces, render it too valuable a procedure, especially in the treatment of the extremely poor risk, to justify its present lack of unpopularity, the same being true of multistage thyroidectomy. The latter procedure, particularly with patients with long standing nodular, toxic goiter associated with serious cardiac disease, emaciation and marked weight loss, is of the utmost utility, and while deaths today rarely follow operation performed upon

cases admitted to 28 hospitals in Philadelphia during 1928 1929 and 1930 the diagnosis of peritonitis was made in less than 10 per cent although peritonitis was a complication in 40 1 per cent of the cases 14 2 per cent of the patients admitted had a spreading and 25 8 per cent a local peritonitis

Every case of peritonitis recorded local on admission must have shown the symptoms and signs of a spreading process before admission These symptoms and signs were sufficient to make a diagnosis only of the appendicitis and not of the peritonitis It is evident therefore that if proper management is to be instituted more attention must be paid to the reaction of the patient to the infection Physical signs are important but a careful history and an honest attempt to determine what nature's defensive mechanism is trying to accomplish is more important

Acute fulminating appendicitis developing within a few hours characterized by suppuration and gangrene without perforation associated with high temperature and pulse rate is not the usual type of appendicitis but even in this type the physical findings are usually those of a local process The indications for operation are definite A patient suffering with this type of infection however if given a laxative will in most instances suffer perforation and the physical findings will vary with the location of the appendix if retro-cæcal or pelvic the perforation may be grossly sealed the physical signs may be and frequently are those of a localized process but the patient has actually a spreading peritonitis as evidenced by his reaction to the infection and if he is operated upon at this time before he has an opportunity to immunize himself against it he will probably die Of every 8 patients 7 that were given laxatives and subsequently developed a spreading peritonitis died Of those that were admitted to the

hospital without a history of having taken a laxative during an acute attack 1 in 80 died of those that took one laxative 1 in 13 died and of those that took two or more laxatives 1 in 7 died

To operate in the presence of a spreading peritonitis invites catastrophe The day has passed when an intelligent surgeon interferes with nature in the localization of a skin or subcutaneous infection by making incisions over lymph channels that are clearly delineated by their redness The surgeon today gives the patient an opportunity to immunize himself against the infection and then when temperature and pulse have subsided the lymphangitis has disappeared and the abscess well walled off he makes a small opening in the center and inserts a drain The management of general peritonitis is identical We cannot see what takes place what we feel is only a slight indication of the extent of the pathological process how the patient reacts tells us a great deal more

JOHN O BOWER

THE MULTISTAGE OPERATION IN TOXIC GOITER

THE ever broadening field of surgical therapy the facility with which operations scarcely conceived a generation or two ago are now performed and the assurance with which formidable procedures upon vital organs are undertaken with every prospect of a successful outcome have led among other forms of technical improvement to the development and increasing use of multistage operations These methods largely of recent origin are exemplified by the procedures of a preliminary colostomy or ileocolostomy before resection of the colon of suprapubic cystostomy in certain cases of prostatic hypertrophy and of graded operations on the lungs the œsophagus and the brain In no field of

Year	Number of cases	Percentage of cases	Number of deaths	Percentage of deaths	Number of hospitalizations	Percentage of hospitalizations	Number of intensive care unit admissions	Percentage of intensive care unit admissions	Number of long-term care facility admissions	Percentage of long-term care facility admissions	Number of deaths in long-term care facilities	Percentage of deaths in long-term care facilities
2019	1,234	100%	45	100%	1,100	100%	200	100%	100	100%	10	100%
2020	2,345	100%	120	100%	2,100	100%	400	100%	200	100%	20	100%
2021	3,456	100%	180	100%	3,200	100%	600	100%	300	100%	30	100%
2022	4,567	100%	250	100%	4,300	100%	800	100%	400	100%	40	100%
2023	5,678	100%	320	100%	5,300	100%	1,000	100%	500	100%	50	100%
2024	6,789	100%	400	100%	6,400	100%	1,200	100%	600	100%	60	100%
2025	7,890	100%	480	100%	7,500	100%	1,400	100%	700	100%	70	100%
2026	8,901	100%	550	100%	8,500	100%	1,600	100%	800	100%	80	100%
2027	9,012	100%	600	100%	8,500	100%	1,700	100%	850	100%	85	100%
2028	9,123	100%	650	100%	8,500	100%	1,800	100%	900	100%	90	100%
2029	9,234	100%	700	100%	8,500	100%	1,900	100%	950	100%	95	100%
2030	9,345	100%	750	100%	8,500	100%	2,000	100%	1,000	100%	100	100%

the thyroid the number which do occur can surely be decreased by more thorough study of the patient more careful pre-operative preparation and most important by exercising greater surgical judgment in adapting the type and extent of the operation to the individual patient

Every surgeon interested in goiter is aware that many patients whose conditions seem perilous frequently recover promptly from formidable operations and with but little reaction while others who are apparently extremely safe risks occasionally succumb following the simplest of procedures. The greater his experience the surer the surgeon becomes that he must ever be on the watch for the unexpected must circumvent it if at all possible

Death following primary thyroidectomy nearly always occurs with the patient who would not have succumbed had a divided operation been performed but what patients to select for the procedure is a difficult problem the parallel of which is not to be found in the treatment of any other surgical condition. It is realized that all patients can not be subjected to such a routine but there are certain ones for whom the multistage operation is certainly indicated

That one surgeon cites a long series of operations performed in one stage with little or

no mortality while the next who occasionally utilizes the more conservative procedures allowed to has a much higher death rate proves nothing neither does the fact that in a given series the only patients who died were those operated upon in stages. All the factors must be tabulated before an accurate comparative appraisal of end results can be made and conclusions drawn a principle which applies to all statistical analysis

Pre-operatively administered Luol's solution as helpful as it definitely is does not necessarily assure a successful outcome following a primary thyroidectomy. Prolonged incorrect use of iodine has a real bearing on the results a fact repeatedly emphasized quite recently by Goetsch who again stated that iodine should be employed solely in the preparation of the toxic patient for operation

If any lesson is to be learned from all this it is that one should not be greatly influenced by what may prove but a temporary vogue to give up old and dependable friends but should exercise certain individuality based on one's own experience provided of course it has been sufficiently extensive and this applies particularly to the surgical treatment of toxic goiter where judgment of an especially high degree is demanded in properly fitting the operation to the individual patient.

HAROLD L. FOSS

MASTER SURGEONS OF AMERICA

SAMUEL M D CLARK

BY birth, inheritance, education, and lifelong residence in his native state, Samuel Marmaduke Dinwiddie Clark was a thorough Louisianian. He was born at Devall, West Baton Rouge, on his father's plantation, on July 28, 1875, and was approaching his fiftieth birthday when his career of great activity and usefulness was abruptly brought to a close by the fatal illness (diabetes, cardiovascular disease), which ended April 26, 1925.

Death came at a time when the splendid promise of his early years was being fulfilled and he was reaping the reward of a life of brilliant and constant service to his people, to his profession, and to the institutions with which he was connected.

His father was William Lobdell Clark, of Clarkland Plantation, Louisiana, his mother, Mary Elizabeth Devall, of Smithfield Plantation, West Baton Rouge Parish, Louisiana, and he inherited from each the qualities which were so distinctive of his character and personality. Like the sons of most planters of the last generation, his early education was entrusted to private tutors. He was graduated from the Louisiana State University in 1895 with the degree of B Sc, after having been captain in the cadet corps during his senior year. In the fall of the same year he entered the School of Medicine of Tulane University and served as undergraduate interne at the Touro Infirmary in 1897. He was also an interne at the Charity Hospital from 1898 to 1900, and was graduated M D, Tulane, in 1900.

In 1903, he was appointed assistant demonstrator of operative surgery under Professor Gessner in the Miles Laboratory of the Tulane School of Medicine. In 1904-1905 he was chief of clinic for Professor Lewis at the Charity Hospital, and in 1905 he was appointed lecturer and clinical instructor in gynecology and obstetrics. In the interim he was secretary of the Orleans Parish Medical Society and of the Charity Hospital Alumni Association of Louisiana. In 1907, he was elected assistant professor of gynecology in the School of Medicine under Professor Lewis. On the retirement of Professor Lewis, in 1911, his chair was divided, Dr. Clark succeeding him as full professor of gynecology and clinical obstetrics, and Dr. C. J. Miller, likewise, as professor of obstetrics and clinical gynecology. From 1911 to 1925, fourteen years, Dr. Clark served uninterruptedly as the effi-



SAMUEL M. D. CLARA
1875-1923

of Louisiana and of the surrounding states are proof of the merit and weight attached by his colleagues to his discussions and of the appreciation in which he was held by the profession throughout the country

While intensely interested in his work and giving his best thought and energy to the discharge of his duties, whether in the classroom, at the operating table, or at the bedside, he was capable of the fullest relaxation and enjoyment of the amenities of life when the tension of his immediate task was over. Dr. Clark's popularity as a club man, with his students and in all social gatherings, in and out of the profession, is easily accounted for by his many lovable traits and genial characteristics. Physically endowed with a very attractive and approachable personality, he possessed an unusual inborn capacity for captivating friends and entwining himself in the affections, not only of his patients, of his students, and of his associates, but of all the men and women with whom he came in contact. Of graceful manner and speech, he was delightful as a *raconteur* and always a charming companion on any occasion. Though playful and wonderfully adaptable to any environment into which he might be thrown, he was none the less very firm and determined in his opinions and convictions. Though seemingly docile, even shy and unobtrusive, he was thoroughly conscious of his rights, and whenever these were trespassed, or he suspected that they were trifled with, he was sure to assert himself in a way that left no room for cavil or doubt. He was every inch a man, strong in his likes and dislikes. While he had long schooled himself to control his emotions and reactions, he was quite frank and always dependable in whichever direction he was led by his convictions. It was the charm of his personality and the virile quality so dominant in his composition which contributed largely to his popularity and to the tenacity and loyalty in which he held his friendships.

In closing this very inadequate sketch of Dr. Clark's distinguished career, reference should be made to the memorial resolutions adopted by the Faculty of the Medical School of Tulane University, which testify in feeling terms to the distinction that he gave to his department during the twenty-two years that he served and taught in his Alma Mater, to the affection in which he was held by his pupils and fellow workers, and to the great void caused in the school by his untimely loss.

RUDOLPH MATAS

cient head of the department of gynecology. Joined to his professorship in the medical school he taught and practiced at the Charity Hospital as visiting gynecologist of that institution and later became a member of the staff of Toussaint Hospital in a similar capacity continuing in both of these positions to the time of his death.

In addition to his active and conspicuous membership in the Orleans Parish Louisiana State and American Medical Associations Dr. Clark was a Fellow of the Southern Surgical Association (Vice president 1915) of the American Gynecological Society the Southern Medical Association and of the American College of Surgeons. In all of these he was a prominent figure participating most actively in all their proceedings and contributing valuable papers and discussions.

During the World War Dr. Clark was appointed Major in the Medical Corps and the first chairman of the medical section of the Council of National Defense in Louisiana. He was among the first surgeons to join the medical reserve corps and was assigned by the Surgeon General to the special and important duty of inspecting the base hospitals in the cantonments. Selection for this delicate and difficult task was in recognition of his wise knowledge of operative surgery his hospital organization and early training as a military cadet. When his tour of inspection had been completed he was again detailed for special duty overseas with the expeditionary forces in France where he also rendered valuable service.

Dr. Clark found time amid his large professional interests to participate in the social life of the metropolis. He was a Mason a member of the Boston Club Audubon Golf Club New Orleans Club and Kappa Sigma and Phi Chi Fraternities in all of which he was a prominent and highly esteemed member. He was passionately devoted to the outdoor life and golf claimed his presence on the links whenever he could spare a moment to indulge in his favorite exercise.

In 1902 he married Miss Elise Cockerham prominent in the social life of Natchitoches who survives him. He is also survived by a sister Mrs. Walker B. Spencer and a brother W. L. Clark both of New Orleans.

Though not a voluminous writer Dr. Clark contributed a number of very valuable and impressive papers to the medical press and to the *Transactions* of the societies of which he was a member. He wrote on subjects that especially interested him and which attest to his unusually clear and eminently practical judgment his skill as an operator his vigorous and progressive tendencies and his broad learning in the literature of his profession. His papers on Cesarean Section Treatment of Carcinoma of the Uterus Pelvic Infections Endometrial Transplantations Surgical Treatment of Visceroperitonitis Radium etc. are merely cited among many other contributions to show his wide and varied interest in his specialty. He was always a ready forceful pleasing speaker in all matters that interested him or that concerned his province. The frequent invitations that he received to address the various parish and district medical societies

Hon J S Smith, professor of medical jurisprudence This was the first faculty actually to give medical instruction in the Pacific Northwest Dr H Carpenter was elected dean

The first course of lectures was begun on March 3, 1867, and at the Commencement of that year, W A Cusick, D M Jones, and J L Martin were graduated in Medicine The second term was begun November 4, 1867, and continued 20 weeks Attendance at two courses of lectures was required for graduation The facilities for medical instruction in Salem were most meager The entire equipment of the university, so called, consisted of one building, in which were lodged all departments, college, preparatory, and now, medical There are references to a separate building for dissection, apparently a shed The clinical facilities may be judged from the fact that the population of Salem at the time was about 1,200, and all of Marion County, in which Salem is located, had 7,000 people However, as compared with many other medical schools, even in the older settlements of the East, the new department at Salem does not suffer too much It was established in the belief "that the interests of the country would be promoted"

While the faculty was appointed by the Board of Trustees of the university, the connection between the two bodies appears to have been more in name than in fact Many misunderstandings arose, partly within the medical faculty itself, and partly from the inclination of many of the faculty to govern itself without reference to the Board Within less than 2 years, a resolution was presented to the Board to discontinue the medical department The resolution was tabled and the department continued in operation Dissensions within the faculty continued, largely over the professorship of surgery, which "became a bone of contention and required all the patience and management to prevent an open rupture" The faculty reorganized, but there were several years of difficulty and disagreement The story of these years is somewhat fragmentary, much of the record having been lost

In 1870, it was proposed to donate ground belonging to the university for a hospital, but this plan was not carried out Three years later



Horace Carpenter, M D (1826-1893)
First dean of the Willamette Medical School

the Board appropriated funds to rent quarters for the department in the town Doctor Carpenter, who had been dean at various times, who continuously served as professor of surgery, and around whom many of the disagreements had arisen, resigned in 1875 Dr D Peyton was made dean for a time, and in 1876 twenty-three matriculants were registered in the department Two years later, June 10, 1878, the Board of Trustees of the university voted to move the department to Portland, 55 miles away, where the initial attempt had been made 13 years earlier to establish it Dr O P S Plummer, of Portland, was then made dean and

a new faculty was appointed, although it included some who had served at Salem Instruction in Portland formally began on December 16, 1878, but the first faculty meeting was held on June 18, 1878

The school was housed in rented quarters and dissecting was done in some rooms above a livery stable for many years, although efforts were made from time to time to obtain more suitable quarters It was not until 1887 that it moved into a building erected for purposes of medical instruction, which for its day was well designed and equipped The funds for its erection, about twenty-five thousand dollars, were obtained from the Methodists of the state It appears that perpetual scholarships were issued to contributors to the amount of five hundred dollars This method of securing funds was used by other educational institutions during this period in the development of the state

The motives which led to removal to Portland are not far to seek In addition to the dissensions of the faculty at Salem, there remained the question of population In 1878, Salem had about 2,500 people while Portland had grown to 19,128, and so provided more abundant facilities for instruction Another factor appears to have been the activities of the Oregon State Medical Society, which was organized September 1, 1874 At its second meeting, the following year, an active interest in medical education was manifested in the appointment of a committee on medical education, with instructions to report annually on the general condition of medical education in the

EARLY AMERICAN MEDICAL SCHOOLS

WILLAMETTE UNIVERSITY MEDICAL SCHOOL

O LARSELL PH D PO TL ND OREGO
U or IO g M h al bood

THE third medical school to be founded west of St. Louis appears to have been that organized in Salem, Oregon, on February 15, 1865, by the Board of Trustees of Willamette University. In point of continuous existence until it closed its doors in 1913, it was the oldest from the time of first organization, although Toland Medical College, now the University of California Medical School, began actual instruction somewhat earlier. It may also be noted that the medical department of the University of the Pacific, which later became Cooper Medical College and is now continued as Stanford University Medical School, was founded in 1858 but discontinued in 1864, to be later resumed. The Oregon school was organized as the medical department of Willamette University. It was to be located at Portland under the name of Oregon Medical College.

Willamette University was founded at Salem in 1842 by Jason Lee, the pioneer Methodist Episcopal missionary to the Oregon country. Lee and his associates had come to Christianize and teach the Indians, but the decimation of the Northwest tribes by the great epidemics which swept Oregon one hundred years ago and continued for a number of years, so that the native population was greatly reduced, led Lee to turn his attention to the education of the children of the increasing white population. He founded the Oregon Institute, with the definite aim of affording higher education to the white children of the Oregon country. The name was later changed to Willamette University.

In 1865, only 6 years after Oregon was admitted to statehood, another significant step was taken in the launching of a medical department. Governor A. C. Gibbs and others had taken the initial steps in 1864 by sending a communication to the Board of Trustees of Willamette University asking them to organize a medical department and to locate it at Portland. At the meeting of the Board the following February, a favorable action was taken. Provision was made by which

the Board should appoint the medical faculty.

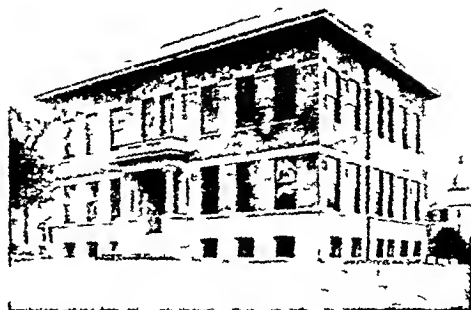
A faculty was elected and a temporary office of the school opened in Portland, but difficulties arose which resulted in temporary postponement of the project. The first faculty consisted of R. Glisan, M.D., professor of the theory and practice of medicine; J. A. Chapman, M.D., professor of civil and military surgery; A. W. Loryea, M.D., professor and demonstrator of anatomy; R. B. Wilson, M.D., professor of physiology and institutes of medicine; Hon. A. C. Gibbs, professor of medical jurisprudence; and Judge M. P. Deady, eminent professor of medical jurisprudence. This faculty never gave instruction. It is interesting to note that an eminent professor, the leading lawyer in the State, was included before the school began to function.

In June 1866, steps were taken to bring the department into operation. This was apparently due in large part to the influence of Dr. J. H. Wythe, a physician, preacher, and educator, who became president of Willamette University in October 1865. Since the medical department had failed to begin its work in Portland, it was proposed to locate it at Salem with the other departments of the University. After some negotiations through committees with the previously named faculty, the latter resigned their positions and discontinued their relations to the University. The Board voted on November 14, 1866, to establish the medical department at Salem. The following new faculty, consisting of physicians, a resident in and near Salem, was elected, namely: Horace Carpenter, M.D., professor of civil and military surgery; E. R. Fiske, M.D., professor of pathology and practice of medicine; John B. Well, M.D., professor of obstetrics and diseases of women and children; J. H. Wythe, M.D., professor of physiology, hygiene, and microscopy; D. Peyton, M.D., professor of materia medica and therapeutics; J. W. McAfee, M.D., professor of chemistry and toxicology; A. Sharples, M.D., professor of descriptive and surgical anatomy; W. C. Worme, M.D., demonstrator of anatomy.

and into which it moved in 1905. The department continued to occupy this building until 1913, when it was discontinued by merger with the University of Oregon Medical School, which in the meantime had outgrown the older school. The number of students in 1908-1909 was thirty-four, but increased to sixty in 1911-1912. When the school discontinued in 1913, there were two hundred thirteen alumni on its roll since the first class of 1867. This alumni roll is an honorable one. It includes many of the best known and best loved physicians of Oregon and the Northwest.

After its return to Salem in 1895, the school made a valiant struggle for existence, but with the handicaps of very limited funds and scarcity of material in this smaller city, it was impossible to maintain the standards set by the Council on Medical Education. The famous Flexner report of 1910 on "Medical Education in the United States" scored the Willamette Medical Department very severely, but in spite of this it continued to attract increasing numbers of students. Dr. W. H. Byrd, the dean during its last years at Salem, made every effort to build it up, but the task was too great to accomplish with very limited financial resources. After brief negotiations the merger with the stronger medical school of the State University, to which reference has already been made, was accomplished on March 23, 1913, under an agreement which protected the alumni of the older school.

In the light of present standards of medical education, the Willamette Medical Department, in common with very many of its contemporaries, had serious shortcomings. During all of its history it suffered from handicaps of poor equipment, dissensions in its faculty, and difficulties of all sorts, in a thinly populated state, far removed



Building erected in 1905 for Willamette Medical School at Salem, Oregon, after the school moved back to Salem.

from centers of medical education. It struggled on as long as was possible and gave of the best it had to the young men and women who were eager for medical training, but who did not find it possible, early in their course at least, to go to the larger medical centers of the East.

To the memory of the school founded under pioneer conditions, we may now lay a wreath in honor of its having accomplished the expectation of the Board of Trustees of Willamette University who first launched the school in 1865, in the belief "that the interests of the country would be promoted."

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state and on requirements for graduation etc Three years later a special committee was appointed to attend the examinations of the medical department of Willamette University and the address of Dr L L Rowland president of the society in 1878 had for its topic Medical Education There was a considerable interest in the subject on all side

However a more immediate factor which led to moving the department was the organization in 1877 under the old name of

Oregon Medical College of a proposed school in Portland with several of the original faculty of 1865 on its list The Willamette faculty was invited to appoint a committee to confer with a committee of the new school to devise a plan if possible whereby the interest of both institutions may be so harmonized as to lead to the continuation of one medical college made capable of offering the most complete facilities of obtaining a medical education As a result of the negotiations between the two committees the Willamette faculty in June 1878 recommended to the Board of Trustees of the university that the medical department be transferred to Portland on the abandonment of the projected medical school there

The Willamette medical department was strengthened by the better facilities of the larger town and the establishment of a rival school was forestalled In June 1879 the faculty adopted the articles of confederation and the standards of the Association of American Medical Colleges and under date of August 3 1880 it is noted in the faculty minutes that the school had been admitted to membership in this association

Dr E P Fraser was elected dean in 1880 and in October 1884 plans for a medical school building were discussed The need of such a building had been recognized for some time In May 1884 the Board of Trustees of the university had authorized its financial agent to devote part of his time to securing funds for the proposed building In 1885 construction was begun and the building which was a source of pride to the school was occupied in 1887 It contained a dressing room with a capacity of twenty tables a refrigerating plant large enough to care for thirty bodies and a auditorium with a seating capacity of one hundred fifty people For its time it appears to have been well designed and equipped



Building of the Oregon Medical School in Portland

Educational requirements were not rigid but this was generally true of American medical schools. In 1877 the requirements for admission provided that applicants must satisfy the dean of the medical faculty that he possessed the elements of a good English education Previous to this time the requirements had been ill defined and the adoption of the above regulation resulted in a diminished attendance The course of lectures still continued 20 weeks and attendance at 10 courses was required In 1883 this was in

creased to attendance on three courses of lectures with certain specifications as to sequence of subjects An attempt was made in 1884 to institute a preliminary course of training before medical instruction was begun.

In 1887 as the school was about ready to occupy the new building a serious change took place in the faculty The causes are somewhat obscure but appeared to involve some changes in the staff As a result the entire faculty resigned Dr E P Fraser the dean however continued as acting dean A new faculty was appointed by the Willamette Board which included many of the men who had resigned and some new names from among practitioners of Portland Several of the more prominent members of the old faculty however were not included These together with other prominent physicians of the city organized a second medical school which through connections with the president of the Board of Regents of the State University was taken under the wings of the latter school and called the University of Oregon Medical School Rivalry was bound to result and for a time there was much bitterness The faculty of the new school controlled the better hospital facilities and the Willamette Medical Department in spite of its new building found itself in difficulties It continued to give instruction in Portland until 1895 when the Methodist Hospital its last hospital connection as lost The school found itself entirely without hospital facilities The faculty appealed to the Board of Trustees of Willamette University for aid Apparently nothing could be done in Portland and the Board was unwilling to see the school die after 28 years of continuous history so they provided quarters for it again at Salem

The citizens of Salem subscribed funds for a new brick building on the Willamette campus which was erected for the medical department

miscellaneous illustrations. In other words, the work shows the various stages of a disease in one and the same case and not the different stages of a disease in different patients. The various cases chosen very satisfactorily cover the whole subject of bone and joint diseases. Sufficient clinical data accompanies each roentgenogram. A valuable contribution which will prove useful to radiologists, orthopedists and general surgeons.

JAMES T. CASE

THE radiophysiology and the physical bases are the same whether radiotherapy be deep or superficial. The term deep therapy has come to be used in designating the technique, and especially the delivery, of a sufficient depth dose of high voltage X-radiation filtered through heavy metals. Employing a minimum of algebraic formulæ, the authors of *Radiotherapie*¹ present the physical data necessary for radiotherapy. Much space is devoted to radiophysiology. The third section sets forth a rational method of irradiation based on the physical and radiophysiological data. The final section is a clinical application of the foregoing. The work is well written, fairly complete, readable, and very helpful.

JAMES T. CASE

ALTHOUGH written by ten authors *Midwifery*¹ has overcome some of the disadvantages of collective authorship because the whole corps acted in an editorial and revisional capacity on every chapter of the book. All ten authors are teachers in London medical schools and among them are represented eight general hospitals with medical schools and three large lying-in hospitals.

In the treatment of eclampsia, conservatism is favored. However, general anesthesia is looked upon as more advantageous than spinal or local anesthesia for the delivery of women with toxæmia. This idea is contrary to the belief of most American obstetricians who are convinced that all inhalation anesthetics, especially chloroform, have some deleterious effect on the important abdominal viscera particularly the liver. Furthermore a general anæsthetic increases the risk of pneumonia, and eclamptic patients are especially susceptible to this complication. The authors also suggest the use of veratrum

viride and mild diuretics both of which are rarely employed by American obstetricians.

In the treatment of infected incomplete abortion, active intervention is recommended and the finger is considered less harmful than a sharp curette. In this country as well as on the continent most individuals favor conservative therapy for cases of septic abortion.

The treatment of advanced extra-uterine pregnancy is outlined but the therapy of the far more frequent early cases of ectopic gestation is not mentioned. This is to be found in the companion volume on diseases of women.

The statement is made that "a syphilitic child born alive at full time rarely shows any evidence of syphilis until some weeks after birth." While this may be true of external manifestations, it is usually possible to find evidences of syphilis in the newborn by means of Roentgen-ray pictures of the long bones.

The sections devoted to syphilis, gonorrhœa, tuberculosis, and disturbances of the thyroid gland are briefly discussed in striking contrast to an entire chapter devoted to insanity and childbirth and to a chapter on artificial feeding of babies.

The authors say "Episiotomy, the practise of making two small lateral incisions one on each side of the middle line of the perineal body with the object of preventing a deep median tear, is a practise to be advised only in exceptional cases." This explanation and the illustration of an episiotomy indicate that the authors are not familiar with episiotomies as practised rather extensively in the United States.

Regarding pituitary extract, the statement is made that it cannot be used to induce labor and that it is most useful in the later part of the second stage. However, many obstetricians have not infrequently been able to induce labor by means of this substance and unlike the authors have found that when it is given late in the second stage, especially in $\frac{1}{2}$ cubic centimeter doses as recommended, it may result in disaster for the child or the mother.

The type of cesarean section described and illustrated is the classic one. The low, cervical transperitoneal operation which is finding more and more favor throughout the world is not even mentioned in this book.

In spite of these criticisms the book will prove to be very helpful to students and general practitioners. It is written in a very readable style, the illustrations are abundant and instructive and the typography is clear.

J. P. GREENHILL

¹RADIO-THERAPIE. TECHNIQUE DU DOSAGE EN PROTONS. By Charles Guilbert. Paris. N. Maloine 1932.

¹MIDWIFERY. By Ten Teachers. Edited by Comyns Berkeley. M.A. M.D. M.C. (Cantab.) F.P.C.P. (Lond.) F.R.C.S. (Engl.) F.C.O.G. J.S. Faubain and Clifford White. 4th ed. New York. William Wood and Co. 1931.

REVIEWS OF NEW BOOKS

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CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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PLANNING FOR THE 1932 CLINICAL CONGRESS IN ST. LOUIS

THE surgeons of St. Louis will be hosts to the Fellows of the American College of Surgeons and their guests at the twenty-second annual Clinical Congress to be held in that city October 17-21. An attractive program of clinics and demonstrations for their entertainment is being developed by the Committee on Arrangements of which Dr. Evarts A. Graham is chairman and Dr. F. A. Jostes secretary. All departments of surgery will be represented therein—general surgery, obstetrics, gynecology, orthopedics, urology, surgery of the eye, ear, nose and throat.

Operative clinics and demonstrations in the hospitals are scheduled for Monday afternoon at 2 o'clock and for the mornings and afternoons of each of the four following days. A preliminary program of the clinics and demonstrations is being prepared for publication in an early issue of **SURGERY, GYNECOLOGY AND OBSTETRICS**.

Clinics and demonstrations will be given at the medical schools, Washington University and St. Louis University, and at the following hospitals: Alexian Brothers, Barnard Free Skin and Cancer, Barnes, Bethesda, Christian, DePaul, Evangelical Deaconess, Firmin des Loges, Frisco Employees', Jewish, Lutheran, McMillan, Missouri Baptist, Missouri Pacific, Mount St. Rose, St. Anthony's, St. John's, St. Louis Children's, St. Louis City No. 1 and 2, St. Louis County, St. Louis Maternity, St. Luke's, St. Mary's, St. Mary's Infirmary, Shriners', United States Marine, United States Veterans No. 92.

Two important features of the general program are a conference on cancer clinics and a symposium on cancer to be presented at headquarters on Thursday, and an all-day conference on traumatic surgery and industrial medicine on Friday. There will be daily exhibitions of surgical motion picture films, both sound and silent, in the ballroom of the Statler Hotel.

A sub-committee in charge of the program for the section on surgery of the eye, ear, nose and throat has been appointed consisting of the following: L. W. Dean, Chairman, John Green, Max Goldstein, Harvey Howard, William H. Luedde and William E. Sauer. The recommendations of this committee insure an attractive program of clinics and scientific sessions for all those who are interested in these specialties.

The Central Executive Committee of the Congress is preparing programs for a series of five evening meetings to be held in the grand ballroom of the Jefferson Hotel. On Monday evening, at the presidential meeting, the president-elect, Dr. J. Bentley Squier, of New York, will be inaugurated and deliver the annual address. On the same evening Sir William I. DeCourcy Wheeler, of Dublin, Ireland, will deliver the annual John B. Murphy oration in surgery. For Tuesday, Wednesday and Thursday evenings eminent surgeons of the United States and Canada with distinguished visitors from abroad have been invited to present papers dealing with surgical subjects of present-day importance. On Friday evening at the annual convocation of the College the 1932 class of candidates for Fellowship in the College will be received.

The Congress opens at 10 o'clock on Monday morning with the annual hospital conference in the ballroom of the Jefferson Hotel. An interesting program of papers, round table conferences and practical demonstrations dealing with problems related to hospital efficiency is being prepared for presentation at the conference which will continue on Tuesday and Wednesday. Subjects of interest to surgeons, hospital trustees, executives and personnel generally will be discussed.

General headquarters for the Clinical Congress will be established at the Jefferson Hotel, 12th and

CORRESPONDENCE

To the Editor

In SURGERY GYNECOLOGY AND OBSTETRICS (September 1903) their appended letter over the signature of W. Blair Bell in which they state an intimate familiarity with the patient in the review of the literature or an unwillingness to admit priority in compiling the bibliography of the article.

Null p r a which w s p blished in SUR ERY
G NECOLOG AND OBSTETRICS of J nua y 1931 I
shall be obliged to you if you all publ h my reply
to the lett r f Dr Bell

In the first edition (9) of *P n p l s f G*,
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 anatomy v m l p t i sug e v

Dr Bell made the following statement in his letter: Photomicrographs are shown of sections through the anterior genital wall and bladder of the posterior vaginal wall and ectometrium of the various structures indicated in figure 1. As mentioned only again muscle. It is impossible to reconcile this statement with these descriptions of the testis comparing the photomicrographs.

The relations of the vagina are important for it is only a part of the bladder and urethra and it is from the rectum behind by recto-vesical tissue which contains the nodules of muscle between the bands of fascia from the perineal cleft to the levator ani muscles.

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Locust Streets where the ballroom Crystal and Ivory rooms and foyers adjacent thereto on the mezzanine and second floors have been reserved for the exclusive use of the Congress for scientific meetings conferences registration and ticket bureaus bulletin boards executive offices scientific and technical exhibitions etc The grand ballroom of the Statler Hotel at Washington and 9th Streets will be utilized daily for film exhibitions and certain scientific sessions

An application for reduced railway fares on account of the meeting in St. Louis is pending before the railroad traffic associations and it seems assured that a rate of one and one half the regular first class one way fare on the certificate plan will be in effect from all points in the United States and Canada

ADVANCE REGISTRATION

Attendance at the St. Louis session will be limited to a number that can be comfortably accommodated at the clinic—the limit of attendance being based upon the result of a survey of the amphitheaters open at night rooms and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors It will be necessary therefore for those who wish to attend the Clinical Congress in St. Louis to register in advance

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets which plan provides an efficient means for the distribution of the visiting surgeon among the several clinics and insures against overcrowding as the number of tickets issued for any clinic will

be limited to the capacity of the room in which that clinic will be given

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress such fees providing the funds with which to meet the expenses of the meeting To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters This card which is non-transferable must be presented in order to secure clinic tickets and admission to the evening meetings

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SURGERY, GYNECOLOGY AND OBSTETRICS

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VOLUME LIV

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CHORIO-EPITHELIOMA OF THE UTERUS

ARTHUR H. CURTIS, M.D., F.A.C.S., CHICAGO

From Packer Memorial Hospital and the Department of Obstetrics and Gynecology, Northwestern University Medical School

INCLUDING the experience herewith recorded, my acquaintance with chorio-epithelioma of the uterus is limited to an investigation of 5 cases, 4 of which were studied only pathologically, the material being first seen at necropsy.

In a co-ordinated clinical experience covering a period of 16 years, neither Dr. Watkins nor I encountered a single case of chorio-epithelioma, although we were constantly on the lookout for them. During that time we saw several patients with suspected chorio-epithelioma but it was never possible to confirm the diagnosis. All told including more recent years, I have seen perhaps 20 patients referred with a provisional diagnosis of this disease. In only a few was there notable suspicion of chorio-epithelioma after the history had been taken and physical examination had been made, and in no instance, except the one hereinafter related, did further study con-

firm the diagnosis. In passing, it may be well to emphasize that complications of normal pregnancy sometimes arouse suspicion of chorio-epithelioma, several times I have known of a false diagnosis of this dreaded disease, based on microscopic evidence, in cases in which more careful study revealed only retained products of gestation.

An experience such as has just been described is probably unique and I am perhaps unduly skeptical about the real incidence of chorio-epithelioma. Yet I would feel guilty of a serious omission in failing to mention that it is a very uncommon disease. Its frequency is very likely overestimated because the clinical course is unusually rapid and fatal and the pathological picture presented at autopsy leaves a lasting impression. The multicolored, brilliantly hued, hemorrhagic tumor nodules are so striking that one can scarcely fail to diagnose the condition at autopsy after having once viewed the lesions as encountered in the pelvic and abdominal viscera and in the lungs.

The case herewith reported is presented because the clinical evidence was so clear-cut and because the patient was available for thorough study throughout, including complete necropsy examination.

A nulliparous female patient, aged 28 years, married 1½ years, referred by Dr. C. W. Harrington, reported with the following history:

FIG. 2. Chorio epithelioma of the uterus viewed from behind. The colors are almost perfectly reproduced. Hegar's sign was strongly positive. Note the metastatic nodule in the right broad ligament. The opened uterus contained an egg sized, deep red, somewhat pedunculated, hemorrhagic tumor mass.

FIG. 4. Chorio epithelioma. The lungs presented a brilliant picture. The multicolored umbilicated tumor nodules were of rather soft consistency, varied from hickory nut to walnut size and on incision revealed dark brown hemorrhagic necrotic surfaces. The intervening pulmonary tissue was infiltrated with confluent areas of bronchopneumonia. Red brown nodular tumor masses were also present on the adjacent diaphragm.



Fig. 4



Fig. 5

Cl. Ephel. juv. - 10 H.C.I.

on section, revealed hæmorrhagic maroon colored, friable tumor masses, varying from 1 to 3 centimeters in diameter. In cut section of the liver parenchyma these tumors were found to be hæmorrhagic and semi-necrotic and passed over gradually into the surrounding normal tissue.

The right pleural cavity was filled with fresh blood. Acute hæmorrhage had evidently been the immediate cause of death. The lungs held by firm pleural adhesions, presented a brilliant picture. Detailed description of the appearance of the pulmonary metastases appears superfluous in addition to the illustration presented herewith (Fig. 4). The multicolored umbilicated tumor nodules were of rather soft consistency, varied from hickory-nut to walnut size and on incision revealed dark brown hæmorrhagic, necrotic surfaces. The intervening pulmonary tissue was infiltrated with confluent areas of bronchopneumonia. Red brown, nodular tumor masses were also present on the adjacent diaphragm. The heart was normal.

Cerebral metastases were present in the right gasserian ganglion, beneath the cortex of the left cerebral hemisphere in the region of the motor area, and in the silent area of the right occipital lobe (Fig. 5).

Histological preparations, as is usual in these cases, revealed chiefly necrotic tissue, blood spaces and extravasated blood. It was necessary to prepare a great number of blocks of tissue in order to find typical areas of tumor cells. In selected regions were found nests of clear Langhans cells, deeply staining syncytial cells of varied size and in characteristic grouping, also masses of multinucleated large cells which are so characteristic of this growth (Fig. 6).



Fig. 3 Chorio epithelioma. Metastatic nodules in left kidney



Fig. 5 Chorio-epithelioma. Cerebral metastases were present in the right gasserian ganglion, beneath the cortex of the left cerebral hemisphere in the region of the motor area, and also in the silent area of the occipital lobe on the right.



Fig. 6 Chorio-epithelioma. Photomicrograph of pulmonary metastasis revealing lightly staining clear Langhans cells, deeply staining syncytial cells, multinucleated large tumor cells characteristic of this growth, also blood spaces and extravasated blood.

IS THERE A CLOSED LYMPHATIC SYSTEM CONNECTING THE THYROID AND THYMUS GLANDS?

K S CHOUKE, M A, M D, RICHARD W WHITEHEAD, M A, M D, AND ALICE E PARKER B A,
DENVER, COLORADO

Departments of Anatomy Physiology and Pharmacology and the Child Research Council University of Colorado School of Medicine

SEVERAL types of evidence indicate that a relationship exists between the thyroid and thymus. The fact that the thymus gland is hypertrophied in exophthalmic goiter has long been known (2). The thymus is said to enlarge with thyroid feeding and it is claimed that thyroidectomy promotes involution of the thymus. Feeding thyroid extract to the pregnant animal is reported to cause an increase in the size of the thymus in the offspring. The increase or decrease in size of the two organs is said to go hand in hand. Sharpey-Schafer believes this could occur only in early life since under ordinary circumstances the thymus is involuting when the thyroid is becoming more active. However, our ideas regarding the time when involution occurs have been greatly modified, largely through the investigations of Hammar (3).

In commenting upon the physiological relationships between these two glands, Sharpey-Schafer says "in spite of many observations so little is accurately known regarding the conditions under which they occur (under which the glands undergo regression or enlargement)¹, that it will be wise to reserve judgment as to their mutual relations."

These structures are described as having close connections developmentally and anatomically. The thymus is developed from the caudal aspect of the third and fourth branchial pouches. The main part of the thymus originates according to most authorities from the third pouch while that coming from the fourth branchial pouch may be found associated with the thyroid. Thymic tissue having this origin is often found embedded in the thyroid and can be recognized by the Hassall's corpuscles and lymphocytes.

Anatomically, the cervical portion of the thymus varies in location considerably and thymic tissue has been described to exist in

different cadavers from the base of the skull to the pericardium (1). Thymic tissue is not infrequently found embedded in the thyroid as already stated.

The thymus derives its arterial blood supply from the thyroid vessels in part, by way of branches from the superior and inferior thyroid arteries as well as from the pericardial arteries. It is also supplied by branches of the internal mammary artery. The veins from the thymus end in the left innominate vein, the thyroid veins and the internal mammary veins. The lymphatics of the thyroid are described in textbooks of anatomy (7) as leaving the gland cephalomedially to enter some small prelaryngeal nodes cephalolaterally to go to the deep cervical nodes, and caudally to pretracheal and deep cervical nodes. Among the older investigators, King (5), whose work was published in 1836, wrote "They (the thyroid lymphatics) pass out from and cover all parts of the surface of the gland, form some junctions, and proceed, for the most part, into neighbouring absorbent glands. The most important novel fact concerning the thyroid gland is doubtless this, that its absorbent vessels carry its peculiar secretion to the great veins of the body."

Caylor, Schlotthauer and Pemberton (1) have quite recently studied the lymphatic connections of the thyroid in a number of species of animals, and Mahorner, Caylor, Schlotthauer, and Pemberton (6) have made similar studies on the distribution of the thyroid lymphatics in man. Their results are essentially confirmatory of those obtained by previous workers in showing that the thyroid lymphatics pass to nearby lymph nodes whence efferent vessels pass directly or indirectly to the cervical veins. The lymphatics of the thymus are briefly described in most textbooks of anatomy as ending in either anterior mediastinal, tracheobronchial or sternal lymph nodes.

¹The words in parentheses are ours.

SUMMARY

The incidence of chorio epithelioma of the uterus has evidently been overestimated. The disease is not only rare but its presence has often escaped clinical diagnosis so that cases have usually been available for study only after recognition in the pathological laboratory.

The brief report submitted herewith presents a case with a perfect history of chorio epithelioma in which clinical observation was followed by autopsy and complete pathological study immediately after death. Incident to this study colored illustrations were made within the hours immediately following the autopsy before postmortem discoloration had developed in order to portray in life like colors the appearance of the uterine tumors and the visceral metastases.

A feature of special interest is the presence of an easily elicited positive Hegar's sign which is evident not only during life but is confirmed thereafter at autopsy before the removal of the uterus from the opened abdomen. The fact that Hegar's sign persists in the presence of living chorionic cells despite prolonged absence of the fetus is worthy of note.

The appearance of clinical evidence of chorio epithelioma more than a year and a half after birth of an hydatid mole is also worthy of note. It has been generally assumed that evidence of malignancy may be depended upon to appear at a much earlier date. After passage of a typical mole the patient should evidently be kept under close observation for an indefinite period of time.

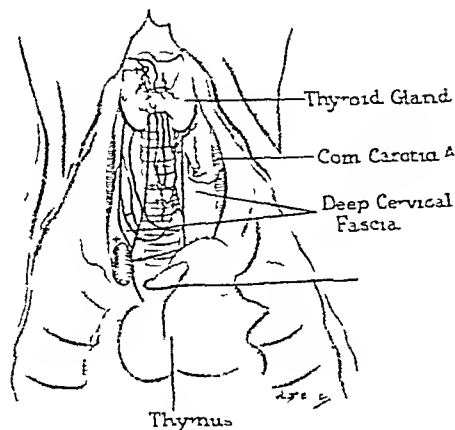


Fig 2 Dissection of injected lymphatics of thyroid and thymus regions from a baby 5 days old. Black lines, lymph vessels, —, lymph nodes.

lymph nodes. The other main branch of the thoracic duct received lymphatic tributaries from the thyroid gland which accompanied branches of the inferior thyroid artery. By ordinary inspection these thyroid lymphatics appeared to emerge from the interior of the thyroid. Further careful dissection showed, however, that they arose only from the superficial surface of the gland.

On both sides, lymph vessels were observed which emerged from the superficial surface of the thyroid gland and followed the course of the superior thyroid artery and vein, but their exact termination was not determined.

Dissection 7. Male child about 4 years old. The thymus measured 6.5 by 4.5 by 1 centimeters. Many small lymph vessels could be found leaving the thymus on both sides. Some of these could be traced to the pericardium and to the lymph nodes along the course of the internal mammary arteries. Other lymph vessels arising in the thymus could be traced to the superficial and deep cervical lymph nodes. Vessels from these nodes were followed to their termination in the right lymphatic duct on the right and the thoracic duct on the left side of the neck. Numerous small lymphatic vessels were found to arise from the superficial part of the thyroid.¹ These were traced to the superficial and deep cervical lymph nodes from whence lymphatics could be traced to their termination in the right lymphatic duct and thoracic duct respectively.

In this and all other dissections which we carried out no direct lymphatic connections could be observed between the thyroid and the thymus.

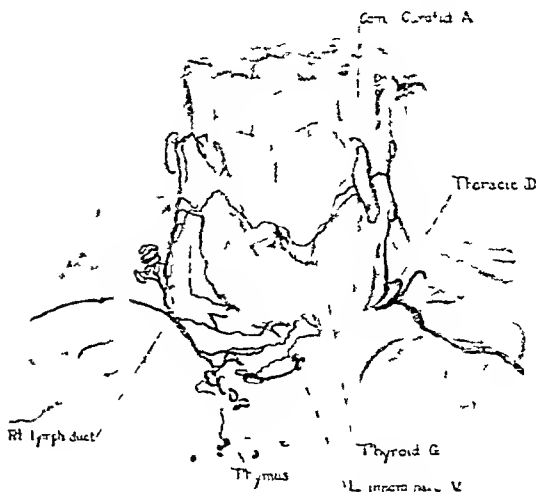


Fig 3 Dissection of injected lymphatics of the thyroid and thymus regions from a man aged 60 years.

The distribution of the lymphatics of this region was very similar in all the cadavers that we dissected. For this reason we do not believe it necessary to present a description of all our dissections as this would be merely a repetition.

INJECTION EXPERIMENTS

Injection of the thyroid gland was carried out in seven human bodies recently dead and unembalmed (1 infant, 1 child, and 5 adults). In all but one of these a modified Gerota's fluid (Prussian blue) was injected into the thyroid on each side. India ink diluted 1:5 was injected into the thyroid of one body. After massaging the gland for a period of from 5 to 15 minutes the course of the lymphatics could be easily traced.

Figure 2 illustrates the lymphatics and the location of lymph nodes in the anterior cervical region in an infant 5 days of age. Similar results were obtained on injection of the dye (Gerota's fluid) into adults and a summary of the findings will suffice to indicate what was found in all these experiments.

After the injections, lymph vessels could be seen extending upward, downward, and laterally from the thyroid. Those passing downward could be seen to enter small lymph nodes on the ventral and ventrolateral surfaces of

¹ In several figures Nonidez shows lymphatic vessels of microscopic size within the substance of the thyroid gland of dogs.

sels are described as running below the thyroid in the thyrothymic ligament (Piersol's ligament) or they run as discrete vessels ending in the thymus without passing through lymph glands

Embryologically, they believe, the thyroid-gill lymph system of fishes has some analogies with the thyroid lymph sac in the human embryo. The thyroid, thymus, and connecting lymphatics are said to lie in a specific fascial plane and it is believed that the lymph sac in fish occupies precisely this plane. "We may infer, therefore, from comparative anatomy and embryology, that the thyrothymic lymph system of mammals is derived from a thyroid-gill lymph system in fish" (13)

Our studies on the connections of the lymphatics of the thyroid and thymus have been limited to observations on the relations of these structures in two species of mammals, human beings and dogs. The present investigation has been purely anatomical in character and hence the discussion of our findings will be limited to this phase of the subject. The results reported lend little support to the contention of Williamson and Pearse favoring a closed lymph system between these two glands. We have shown, both by careful dissection and by injection experiments, that the lymphatics from the thyroid, in common with lymph vessels from other organs of this region, pass to lymph nodes in either the deep cervical group or to nodes in the superior mediastinum. We have noted that, occasionally, the lymph vessels from the thyroid and thymus may enter the same lymph node. In one of the injection experiments in man Gerota's fluid injected into the thyroid could be traced into the thymus after it had passed into and through a lymph node.

Our observations are in essential agreement with those made by Caylor, Schlotthauer, and Pemberton (1) on dogs, and by Mahorner, Caylor, Schlotthauer, and Pemberton (6) on human beings. These investigators studied the lymphatic connections in several species of animals (dogs, swine, rabbits, guinea-pigs, calves, a colt, and man). They found that the lymph drainage system from the thyroid of dogs could be divided into three main groups. In the first group the lymph vessels from the

posterior pole passed to a series of lymph nodes extending along the ventral surface of the trachea and, from these, efferent vessels passed into the thymus and mediastinum. In this group of animals India ink injected into the thyroid was usually visible in the thymic tissue on histological section. In a second group of dogs, the lymphatics from the posterior pole of the thyroid emptied directly into the jugular trunk. In this group, no India ink was found in the thymus. In a third group of dogs, the lymph vessels coming from the posterior pole of the thyroid did not pass through any lymph nodes before entering the general circulation.

A method similar to that used in the study of the lymph connections in animals was followed by Mahorner, Caylor, Schlotthauer, and Pemberton in the investigation of the thyroid lymph connections in man. They found that the lymph vessels leave the human thyroid at three areas (at the superior and inferior poles and the middle of each lateral lobe).

Vessels from the superior pole were found to follow the course of the superior thyroid artery at first and later they turned backward and downward to end in lymph nodes of the deep cervical group. Lymph vessels leaving the inferior pole of the gland passed downward to end in the lymph nodes anterior or lateral to the trachea. In only one instance were they able to trace a lymphatic from the thyroid to the thymus. In this case the connection was made only after passing through a lymph node in the region above the left innominate vein.

It would seem from the results of Mahorner and coworkers that anything resembling a closed lymph system between these two glands is unusual. Their work, of which ours is essentially confirmatory, indicates that there may be a considerable individual as well as species difference in the course taken by the lymphatics leaving the thyroid. Caylor and coworkers found a much closer association between the thyroid and thymus lymphatics in swine than in either human beings or dogs.

Williamson and Pearse have proposed a theory to explain certain phases of thyroid disease which is based on their anatomical and

the trachea or they terminated in lymph nodes just cephalad to the innominate veins. The dye penetrated beyond these nodes in several instances but in only one case did it reach the thymus (Fig. 3).

The lymph vessels which passed upward from the thyroid were not traced in all bodies but in those in which they were followed the vessels were found to empty into superficial cervical nodes.

Laterally lymphatic channels were traced to nodes situated about the carotid arteries and internal jugular veins.

The results obtained by injection of modified Gerota's fluid serve to confirm those secured by careful dissection and they support the view that there are no direct lymphatic connections between the thyroid and thymus although at times lymphatic vessels from the two glands may be found to enter the same lymph node (Fig. 2). Further evidence against a direct lymphatic connection between the two structures was derived from another experiment in which we injected one half cubic centimeter of a dilution of India ink into the thyroid of a male child about 3½ years old who had recently died. After massaging the thyroid gland for about 10 minutes there was no change in the appearance of the thymus and histological sections of the latter failed to reveal evidence that carbon particle had passed into it.

To determine whether similar conditions to those found in man obtain in another species we injected modified Gerota's fluid into the thyroid or thymus of dogs under ether anesthesia or into these glands of dogs recently killed. Six dogs were injected with modified Gerota's fluid (thymus of one animal which had recently died, thyroid of another recently killed, thyroid of four others injected while under ether anesthesia).

In the animal in which the thymus was injected the fluid did not penetrate the entire gland nor did it pass to any lymph nodes even after massaging for about 10 minutes. In four animals the Gerota's fluid was injected into the living animals. In all cases dissection of the cervical region 20 to 30 minutes after injection revealed that the colored fluid had passed down in the lymphatics for a distance

of 1½ to 2 inches to enter lymph nodes caudal to the thyroid. In two of the animals lymphatics could be traced laterally to enter cervical lymph nodes; in the 2 others the fluid could be seen in lymph channels which passed cephalad for about an inch to enter several small cervical lymph nodes. There was no evidence that the fluid passed into the thymus in any of these animals when it was injected into the thyroid. In the one animal which was injected after death the results were similar to those already described.

Two other experiments were performed on young puppies in which a suspension of India ink was injected into the thyroid glands with the animals under ether anesthesia. Three hours later the animals were killed with ether and the thyroid, thymus and intervening tissue were removed intact. The tissues were sectioned to determine whether the ink had passed from the thyroid to the thymus. In neither animal was there any evidence of carbon particles in the thymus on histologic examination of this tissue. This is further evidence that no direct lymphatic connections exist between these two glands.

DISCUSSION

While there is much evidence gained from physiological experimentation and pathological cases to show that the thyroid and thymus glands are related, the exact nature of this relationship remains obscure. Williamson and Wilhamson and Pearce, as previously noted, have reported observations which indicate to them that these two glands are connected anatomically through a closed lymphatic system. These investigators present arguments based upon embryological and pathological studies which they believe add support to their anatomical observations in favor of there being a closed thyrothymic lymph system.

They believe that the special lymph vessels of the thyrothymic lymph system emerge from the thyroid at the hilum at the point at which the inferior thyroid artery enters. From here these lymphatics are described as following the arteries instead of the veins. They found lymphatic comites accompanying the veins and traced them into the nearest lymph glands. The special thyrothymic vessels

necessary link in the chain, how would these latter workers explain the general enlargement of the lymph nodes in cases of Graves' disease?

SUMMARY AND CONCLUSIONS

We have studied the lymphatic connections of the thyroid with a view to determining the presence or absence of a closed lymphatic connection between it and the thymus gland. Careful dissections made on seven human cadavers failed to reveal anything which might be interpreted as a closed lymphatic system between these structures. Similar negative results were obtained in seven experiments in which the thyroid of unembalmed cadavers was injected with India ink or Gerota's fluid and the course of the lymphatics observed.

We may summarize our main findings as follows:

1 In the human cadaver, lymph vessels were observed to emerge from the superficial surface of the thyroid and enter nearby lymph nodes. From these nodes, vessels enter the right lymph duct or the thoracic duct.

2 Lymphatic vessels from the thymus gland can be traced to the superficial and deep cervical nodes and efferent vessels from these enter the right lymphatic or thoracic duct or one of their tributaries. Other lymphatic vessels from the thymus pass to the mediastinum and to lymph nodes along the course of the internal mammary artery.

3 No direct lymphatic connections could be made out between the thyroid and thymus. Lymphatic vessels from both glands may go to the same lymph node, but this condition is rare.

4 Many thin walled veins leave the thyroid at the hilum and these are often difficult to distinguish from lymphatics unless they are traced to their termination.

In one cadaver, following the injection of India ink into the thyroid, microscopic sec-

tions taken of the thymus failed to reveal any carbon particles in the thymus.

Injection experiments were performed on six dogs in which Gerota's fluid was injected into the thyroid. Subsequent dissection showed that the fluid failed to penetrate into the thymus even after massaging the thyroid for 5 to 10 minutes.

In two other experiments on puppies histological sections of the thyroid, thymus, and intervening tissue were made subsequent to the injection of India ink suspension into the thyroid. No carbon particles were visible in the sections of thymus.

We may conclude, therefore, that in both man and dog, there is little or no evidence for a direct lymphatic connection between the thyroid and thymus glands. Likewise, there is no evidence for a closed lymphatic system between these structures.

Since our paper was submitted for publication July 13, 1931, two articles (Gordon, S. D., *Canadian M. Ass. J.*, 1931, **xxv**, 46, and Reinhold, W. F., *Arch. Surg.*, 1931, **xxiii**, 783) have appeared on this subject which present evidence substantiating our results.

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pathological studies. They postulate that some secretion distinct from the iodine containing substance of the thyroid is carried to the thymus via the closed lymphatic system. It is hypothesized that the thymus collects and detoxifies this substance. To quote: *We are forced to the conclusion that thyrotoxicosis would seem to be due to a failure of the lymphatic endothelium of thymus and thyroid to effect the natural detoxication of the lymphogenic secretion produced by the thyroid.* (13)

It would be difficult to explain certain well known facts on this hypothesis. If the functional mechanism which they have hypothesized between these two glands were operative then one could logically expect thyrotoxicosis to result from thymectomy in a certain proportion of animals. Such experimental evidence as is available would be entirely contrary to the assumption that the thymus detoxicates some secretion formed in the thyroid. In spite of the considerable amount of experimental work performed to elucidate the functional significance of the thymus the relationship of this organ to many bodily processes remains somewhat of an enigma. At any rate hyperthyroidism has not been reported to follow thymectomy.

Clinically it is a well known fact that the thymus is hypertrophied in hyperthyroidism. Some years ago it was proposed that Graves disease should be treated by thymectomy. This operation has been performed by a number of surgeons and Halsted has collected reports on 500 cases of thymectomy for hyperthyroidism from the literature. In a certain number of these cases marked improvement has followed the operation. Here again it would seem logical that if the thymus were concerned in detoxicating something produced by the thyroid thymectomy in these cases should prove disastrous. In any event we fail to see how the theory proposed by Williamson and Pearse could explain the good results which have been reported to follow thymectomy in hyperthyroidism.

In a recent article Warthin reviews the pathological findings in Graves disease and he suggests a new point of view with regard to the etiology of this condition. He emphasizes the lymphoid hyperplasia as the chief patho-

logical finding in the thyroid of Graves disease. He looks upon Basedow's or Graves disease as pathological reactions potentially predetermined in the individual at birth by virtue of his constitutional anomaly. The development of the Basedowian or Graves symptoms in so far as the thyroid is concerned is but the expression of abnormal reactions of this constitutional anomaly to the conditions of the life of the individual. The thyroid gland is not the chief pathogenic factor in these various clinical syndromes (toxic goiter toxic adenoma etc.)¹ it is but an incidental complication or sequela comparable to the participation in abnormal reactions of other organs and systems dependent upon the constitutional anomaly. Looked at from Warthin's point of view thyrotoxicosis is always found associated with the general pathological picture of the thymocolymphatic constitution. There is besides lymphoid hyperplasia in the thyroid a hyperplastic or persistent thymus, general enlargement of the lymph nodes and spleen and hypoplasia of the adrenals heart and aorta. Among the European workers Hammar and Hellman (4) have observed enlargement and hyperplasia of the thymus and of lymph nodes generally in exophthalmic goiter cases.

Warthin's views then would be directly opposed to those expressed by Williamson and Pearse to explain the etiology of thyrotoxicosis. According to the former lymphoid hyperplasia is along with certain other constitutional defects the primary condition and only those persons possessing these anomalies will ever develop thyrotoxic symptoms. Williamson and Pearse however while recognizing the presence of status thymocolymphaticus in every case of Graves disease are inclined to attribute the lymphoid hyperplasia to the excessive production of a lymphogenic secretion of the thyroid. The thymus is concerned as detoxicating this secretion and with excessive formation of secretion the thymus shows hyperplasia. If the latter view were correct we should expect every case with status thymocolymphaticus to show thyrotoxic symptoms. Such seems not to be the case. Also if a closed lymphatic system is a

tissue metabolism, and the activity of the removal of waste products are presumably more favorable to healing in young animals than in old. Furthermore, the lipoids of the blood serum extravasated into a wound inhibit healing to a greater and greater extent as age advances (Carrel, 14). But possibly of importance, in the light of the present studies, is the fact that the percentage of water in the tissues decreases progressively from embryonic life to old age (Moulton).

6 Although there may be a sufficient physiological or artificial stimulus to fibrosis, new cells will not form unless the surrounding tissues transmit suitable building materials from the blood stream and transport the waste products from the field of repair.

It is a fact established clinically that wounds heal less rapidly in patients with severe anemia. Wounds in areas of decreased blood supply, as in a limb affected with marked arteriosclerosis or in tissues which have been extensively treated by X-rays (Frey), heal slowly, and Ellis has demonstrated the inefficient healing of skin divided by electro-surgical methods. On the contrary, wounds in excessively vascular areas, such as the face, heal rapidly. Leriche, and Fontaine and Jung have shown marked acceleration in the healing of wounds made in sympathectomized areas. A less than optimum supply of oxygen for the chemical reactions of repair is presumably the fault in the anæmic and arteriosclerotic patients, in whom also the temperature of the tissues may be subnormal. Conversely, in the face, the oxidation is undoubtedly at an optimum and in the sympathectomized areas the oxidation is ample and the temperature normal or increased (Morton and Scott). Furthermore, variations in the degree of oxidation and alterations in local temperature have their effect on the local hydrogen-ion concentration of the tissues (Haebler, Wilson) and on the adequacy of removal into the blood stream of the waste products of chemical reactions (McIver and Gamble).

Delayed healing is expected clinically in patients with marked nutritional or functional disorders such as diabetes, nephritis, impaired liver function, or starvation from any cause. It may be ascribed to unfavorable local tissue

reactions resulting from alterations in the supply of oxygen and food increase in concentration of lactic acid and acetone-bodies, changes in local acidity (Sauerbruch), surface tension, colloidal state of proteins (Girgolaft, Haebler), temperature, and other factors.

7 Controlled experiments have been carried out by Clark, and by Harvey and Howes, which demonstrate, in animals supplied with a protein-rich diet and water *ad libitum*, an acceleration of the healing of granulating and primarily approximated wounds. In particular the latent period is shortened. Protein in all probability increases the rate of healing, (1) by increasing tissue metabolism (Benedict and Carpenter, Clark) (i.e., the rate of chemical change by which new fibroblasts, endothelium, and other elements of the new tissues are formed), (2) by assisting in the proper buffering of the fluids of the wound (Leupold), (3) by supplying immediately the necessary amino acids for the construction of fibroblasts.

Rowntree has remarked that "water reaches every cell in the organism, and through its properties furnishes the opportunity for chemical reactions, for changes in physical state, and for energy transformation." But, although the importance of an adequate body fluid mass (accompanied, as it is with few exceptions, by a proper osmotic, electrolyte, and hydrogen-ion balance) has been recognized in the effective treatment of many acute illnesses (notably by Hartwell and Hoguet, Gamble and McIver, and Orr and Haden in intestinal obstruction, by Marriott, Schloss, Hartmann (37), Hoag and Marples, and Balcar, Sansum and Woodyatt in "inanition fever" and the persistent diarrhoeas of infants, by Cannon, Fraser and Hooper, and Blalock (8, 9) in the shock of trauma and of hæmorrhage, and, more recently, by Underhill in the treatment of extensive burns), no one, so far as we are aware, has attempted to investigate the effect of a deficiency of body fluid on the rate of healing of wounds. The following experiments show that, at least in the stomach wall of the rat, a loss of body fluid delays healing.

EXPERIMENTS

We have followed in general the method described by Harvey and Howes. The body

THE HEALING OF WOUNDS

AN EXPERIMENTAL STUDY TO SHOW THE INFLUENCE OF BODY DEHYDRATION¹

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THE surgeon's most fundamental problem according to Carrel (14) is to acquire a full understanding of the process by which wounds heal. This problem naturally divides itself into a consideration of (1) the factors which control the initiation of the process, (2) those factors which control subsequent growth, and (3) those influences which bring about cessation of healing.

It is certain that these forces are multiple and complex and some of them hidden by incomplete knowledge of the physicochemical processes in tissues are probably not as yet within our conception.

However, several researches over a period of years have brought forth facts which tend toward the solution of the problem.

1. Aside from the consideration of embryological healing (A. Keith) normal growth, physiological replacement of tissue and the growth of tumors, it is evident that there must be a wound before healing will begin. This does not mean, however, that because there is a wound healing is initiated. Carrel (12) showed that even in a healthy animal the fibroblastic response in an uninfected area denuded of skin can be completely inhibited for at least 25 days by covering the area with a layer of preserved fascia. It is evidently not the loss of tissue in itself which initiates repair. There is presumably an element or there are elements within the tissue cells or intercellular fluids which on being set free by the disarrangement of cells and after suitable alteration stimulate the fibroblastic response (Foot).

Loeb considers that repair is essentially a reaction of the tissues to the presence of foreign bodies and that the cells of the tissues surrounding a wound enter the defect by amoeboid motion, there to remove foreign particles and to multiply. The researches of Akaiwa, however, suggest that at least in the case of epithelium growth is dependent on

more than a foreign body stimulus. As is well recognized clinically the bed of an open wound must be in a suitable condition before the epithelium will grow over it (Hartwell).

Carrel and Baker have approached a step nearer the truth by showing that the higher split products of protein digestion acting either as catalysts or as quantitative factors in the chemical reactions of repair stimulate growth. Hammett believes the sulphhydryl (SH) group present in some of these higher split proteins is the essential stimulant.

2. After a wound is made there is normally a period of from 5 to 7 days before the multiplication of fibroblasts and of other tissue elements such as endothelium begins (Carrel and Du Nouy). This may represent the time necessary for the production of the stimulus to growth. Carrel (12) has shortened the latent period in open wounds by applying turpentine, chick embryo pulp or staphylococci. It seems likely that the higher split proteins are present earlier in wounds so treated.

3. Ebeling, utilizing wounds in the alligator which is thermolabile, demonstrated that for a rise in temperature of 10 degrees C. the rate of cicatrization was increased about two-fold. He concluded that in spite of the complexity of the factors which bring about the cicatrization of a wound, it appears that the velocity of the phenomenon depends on the rate at which certain chemical changes take place.

4. Bacterial infection interferes with the healing of a wound (Carrel and Hartmann) but may cause in some instances an increase in the total fibroblastic response by inhibiting epithelialization and allowing time for the connective tissue to proliferate in the base of the wound. The same is true of the presence of large or infected foreign bodies.

5. Age has its effect on the rate of healing at least in open wounds (Du Nouy). The supply of oxygen and nutriment, the rate of

¹ From the Department of Surgery, University of Louisville School of Medicine, Louisville, Kentucky, and from the Laboratories of the Scripps Metabolic Clinic, La Jolla, California. The experimental work was carried out at the latter institution.

grams of standard food per day and the control rats 4.6 grams

RESULTS

Experiment A (Table I) shows the marked weakening of the gastric wounds by starvation plus dehydration, as compared with starvation alone. This is evident in the 4, 6, and 8 day rats though there is an obviously erroneous figure in the second 8 day experimental rat which should be disregarded. The average percentage loss in weight of the control rats is 9.2, of the dehydrated animals 25.4. The average bursting pressure of the control stomachs is 151.7 millimeters of mercury and of the stomachs of the dehydrated rats (ignoring the figure which is in error), 133.4 millimeters. A most significant fact is that in all five instances the stomachs of the dehydrated animals ruptured at the wounds whereas in the animals adequately supplied with water all of the stomachs ruptured elsewhere than at the wounds.

The data and results in Experiments B, C, and D are visualized in Figures 1, 2, 3. The body weights, the food and fluid intake, and the intragastric pressure at the instant of bursting have been averaged for the various animals of like groups to supply a single figure for each 2 day period from the fourth to the fourteenth postoperative days. As shown, the average body weights of the control and experimental animals are almost identical on the day before operation when both groups are on a standard diet with water *ad libitum*. But with dehydration the weights of the experimental animals assume a level consistently lower than those of the control animals.

In Experiment A, accompanying the dehydration and while on a diet identical to that of the controls, the dehydrated rats show a marked weakness of their wounds and likewise of their gastric walls in general. There is a comparative reduction in strength, in one or the other, of 53.3 per cent on the fourth day, 49.2 per cent on the sixth, 12.5 per cent on the eighth, 13.5 per cent on the tenth, 24.5 per cent on the twelfth, and 17.7 per cent on the fourteenth postoperative day. On the fourth day, 5 out of 6 ruptures occurred at the wounds, on the sixth day, 4 out of 6, 2

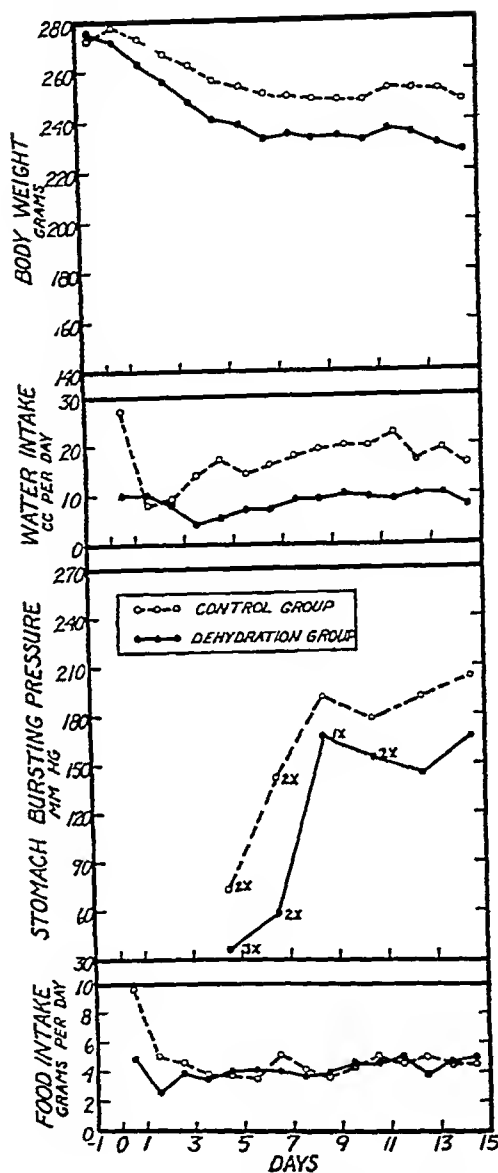


Fig. 1 Experiment B IX, One out of three burst at wound, etc

each in the dehydrated and control groups, but by the eighth and tenth days ruptures at the wounds occurred *only in the dehydrated rats*. Thereafter no more wounds ruptured but the gastric walls of the dehydrated animals continued to burst at pressures lower than in the controls.

is not appreciably lowered, there does occur a considerable reduction in the total mass of muscle. As they remark, this can "only mean a destruction *in toto* of muscle protoplasm producing a corresponding disappearance of water and of substances together."

Although smooth muscle fibers are capable of active regeneration when injured (Berry), the fibrous connective tissue grows much more actively and forms a barrier through which the muscle cells do not penetrate. The resulting healed area is a scar typical for wounds in all tissues of mesenchymal origin. It is fair to suggest that dehydration has a marked inhibitory effect on the processes of repair in general, for example in the healing of grafts.

Delayed healing in dehydrated animals is probably brought about by unfavorable circulatory and nutritional changes in the region of the wound. Moderate anhydræmia results in a decreased blood volume (Keith 45, 46, Gamble, Marriott), peripheral vasoconstriction with decreased volume flow through the tissues (Gesell, Uthelm, McIver and Gamble, Marriott), increased viscosity of the blood (Keith, 46, McIver and Gamble, Underhill and Kapsinow, 75), and stagnation of corpuscles in the capillaries (Marriott, Uthelm, Cannon, Fraser and Hooper). These mechanical factors tend to decrease the quantity of oxygen and nutriment available for the chemical reactions of repair and to prevent the removal of fluid and substances from the region of the wound. Suboxidation results in a decreased rate of tissue metabolism and alters the speed, form, and direction of many of the chemical reactions involved in healing (Haebler).

Leucocytes have been shown to furnish important proteolytic ferments to an injured area (Carrel, 13). If, as is probable in the stagnant tissues of a dehydrated wound, their migration is inhibited, there will result presumably a dearth of higher split proteins acting as stimulants to the reproduction of fibroblasts. Furthermore, the phagocytic activity of leucocytes and macrophages is lessened in all probability under the influence of dehydration.

Wounds undergoing normal healing are almost universally slightly acid in reaction

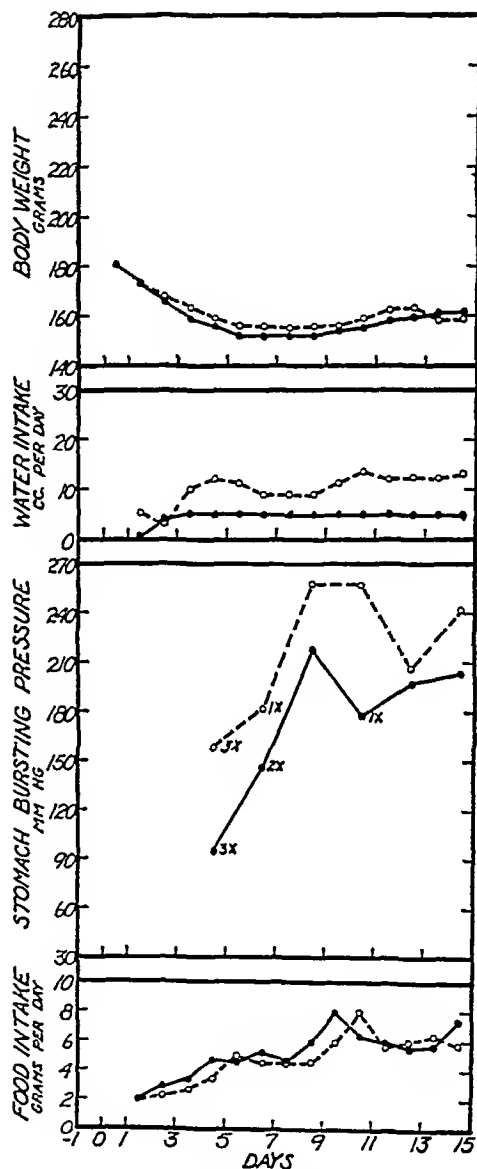


Fig 3 Experiment D

(pH 6.97–6.32, Gurgolaff, Haebler) and acidity favors repair, [e.g., the dissociation of oxy-hæmoglobin is more complete (Wilson) and thus favors both the availability of oxygen and the quick buffering of carbon dioxide on its return to the blood stream]. But Haden and Orr have shown a marked reduction in the oxygen content of venous blood in dogs

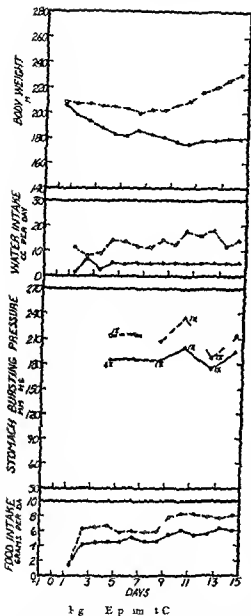


Fig. E p m t C

Figure 2 shows a fairly striking weakness of the gastric wounds or walls in the young dehydrated male rats. The results in this experiment are open to criticism, however, since the control animals ingested more food than the experimental rats. This may possibly account for the quite marked gain in weight of these control rats, a gain which would nor-

mally occur in young animals were it not for dehydration. The surprisingly high bursting pressures of both the control and experimental stomachs on the fourth and sixth days are due apparently to the use in suturing these wounds of No. 00 plain instead of No. 000 plain catgut. Harvey and Howes have shown that No. 000 plain catgut has no appreciable strength after 72 hours but this evidently is not true of the No. 00 plain catgut.

In the final series graphically presented in Figure 3 the experiment is very carefully controlled to eliminate the possible effect of varying sizes of catgut and of food. In fact we slightly overfed the experimental rats as compared with the controls. In spite of this the dehydrated animals show a marked reduction in the strength of their gastric wounds and of their gastric walls, i.e., there is a weakening of 39.2 per cent on the fourth, 19.8 per cent on the sixth, 15.3 per cent on the eighth, 30.3 per cent on the tenth, 5.3 per cent on the twelfth, and 16.5 per cent on the fourteenth day as compared with the litter mate controls which were identical in every respect except that they were allowed on the average slightly more than twice as much water per day.

DEDUCTIONS

Frequently in our experiments just as in those of Harvey and Howes the stomachs ruptured under pressure at points other than at the wound. In the dehydrated animals not only more of the stomachs ruptured at the wound but throughout each series where the ruptures occurred elsewhere than at the wound the pressure necessary to cause the break was lower than in the rats supplied with adequate fluid. These facts indicate (1) that during the early days of healing the wounds in the dehydrated animals are on the average weaker than in the controls, and (2) that throughout the entire experiment the total strength of the gastric wall in the dehydrated animals is less than in the normal rats. The explanation for the latter finding may be found in the work of Drake, McKhann and Gamble who found that when utilizing rats dehydrated as a result of pyloric obstruction although the percentage of water in muscle tissue (of which a large portion of the gastric wall is composed)

the reaction in wounds in peripheral tissues is usually acid, as is suggested by the interesting work of Rous and Drury. Anhydræmic patients have always a marked oliguria and a high specific gravity of the urine but there is no evidence to warrant the assumption of either structural damage or functional deficiency of the kidney itself (MacKay and MacKay, Bessau, Rosenbaum, and Leichtenritt).

If dehydration inhibits the healing of wounds the obvious corollary is that adequate fluid should be supplied during the time of healing. Many individuals ingest habitually a minimum amount of water (MacCordick, Dobson) and may be moderately dehydrated at the time of accidents or, unless care is taken to prevent it, at the time of operation and during the healing period. This is true not only in outlying military hospitals and in the tropics but in civilian hospitals in temperate zones. If there is a loss of body fluid and substances through vomiting, purging (Underhill and Kapsinow, 75), diarrhea, a fistula, or excessive perspiration, the condition is sharply aggravated. Chronic anæmia or a gross hæmorrhage or shock increases the need for fluids while the diabetic, the aged, the arteriosclerotic, the victim of thrombo-angitis obliterans or Raynaud's disease requires particular attention in this regard whenever wounds are expected to heal in poorly vascularized areas.

The work of Harvey and Howes shows that wounded patients should be supplied with an adequate diet which is fairly high in protein content but we would add that water should be given in quantity in conjunction with the protein. For Schiff (70) has demonstrated that "dehydration intoxication" occurs regularly in exsiccated animals fed on a high protein diet but that the condition does not arise in the event of dehydration on a carbohydrate or fat diet.

DeTakats has latterly criticized the wholesale and routine forcing of fluids, particularly following operations. We believe, however, that continued emphasis should be placed on the need of the organism for water and salts and that except in those individuals with marked cardiac or renal deficiency no harm and much good will come from the administra-

tion of from 3,000 to 6,000 cubic centimeters of fluid in each 24 hours immediately preceding and following operation. The amount of fluid which may produce what Greene and Rowntree term water intoxication far exceeds this quantity (Haldane and Priestley, Adolph) provided that enough sodium chloride is supplied to maintain the proper electrolyte and osmotic equilibrium (Moss). In fact, it is impossible to produce water intoxication if adequate and suitable electrolytes are supplied together with the water.

From a clinical standpoint, the most useful criteria of the presence of adequate tissue fluid are a moist, clean tongue and a copious urinary secretion with low specific gravity. It is fair to state that during the time of healing, the specific gravity of the urine should never be allowed to exceed 1.015.

CONCLUSION

The experiments show that moderate dehydration in rats, comparable to states of dehydration observed clinically, result in striking weakness in gastric wounds and in the gastric walls elsewhere than at the wounds. These effects are marked up to at least 14 days after operation, the limit of time to which the experiments were carried.

It is suggested that dehydration has a marked inhibitory effect on the processes of repair in general and that even after as short a period as 4 days there is sufficient destruction of body protoplasm to weaken considerably many tissues, whether or not they have been operated upon.

Such experimental results demand a continued and reiterated emphasis on the value of an adequate supply of fluid for injured patients of all types. It is, of course, important to bear in mind that dehydration can neither be prevented nor cured by water alone. Sodium chloride must be supplied in addition.

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dehydrated by means of a high intestinal obstruction. This finding implies a subordination of tissues which in turn results in a level of tissue acidity which is far above the optimum. Phosphoric sulphuric carbonic and organic acids chiefly lactic are produced in increased amounts and as a result of diminished volume flow and capillary congestion are only inefficiently removed from the region of the wound.

It is entirely probable that local changes in the amount of free tissue water in the nature (Gamble and McIver) amount and concentration of electrolyte in the total osmotic pressure of the intercellular and intracellular fluids in the circumstances of surface tension and adsorption at the cell membrane and in the lipid concentration of the wound fluids may all influence the reactions responsible for healing. Dehydration obviously may alter any of these relationships and may bring about a localized failure of what Cannon calls homeostasis.

The moderate dehydration in our rats could not have been sufficient to cause exsiccation of tissue cells. This occurs probably only in extremely dehydrated animals near death (Underhill and Fish Hill). When dehydration is moderate tissue acidity as a rule increases whereupon according to the principle of Donnan ionized chlorine shifts from the intercellular plasma to the cells carrying water with it (Van Slyke Wu and McLean Hartmann 38).

Although Keith and Whelan have proved that in dogs dehydration brought about by the intravenous injection of pure hypertonic saccharose or glucose does not cause fever the injection of only lightly impure sugar or salts does so (Keith 47 Balcar Sansum and Woodyatt) and clinically speaking states of dehydration are usually accompanied by fever (Rosenstern Shoenthal). If a healing tissue were thus subjected to an increased temperature healing would be favored but as a rule the harmful factors attributable to dehydration greatly overbalance this apparent advantage. For example in many instances even though the body temperature in general is above normal peripheral areas are probably normal or subnormal in temperature.

Marrnott and Spiegler point out that foods especially fat and protein probably are ab-

sorbed poorly from the alimentary tract during anhydramia. Although in our experiments the ingestion of food by the dehydrated animals was qualitatively and quantitatively approximately equal to that in the controls it is recognized that a difference in absorption might alter the conditions of nutrition in the wound. We do not believe however that this is a significant factor.

It should be noted that according to the results of Rose Stucky Mendel and Cowgill anhydramia is accompanied by gastric atony and anorexia the more marked the greater the dehydration. In their dogs a complete atony was accompanied by absolute refusal of food. Our rats did not refuse food but had little appetite. Presumably if moderate atony had any effect on the healing of a gastric wound it would favor the process by providing rest and relative immobility for the part.

Our effort in these experiments has been to produce a dehydration which would simulate that which might occur in wounded or post-operative patients. Such a dehydration (by limitation of fluid intake) produces in addition to the unfavorable circulatory changes previously mentioned a slight rise in the hydrogen ion concentration of the blood (Gamble Marrnott) a more marked rise in the hydrogen ion concentration in the tissues (Rous and Drury) a rise in percentage of hemoglobin (Keith 45 McIver and Gamble Underhill and Kapsnow 75) an increase in plasma protein (Peters Eisenmann and Bulger Hartmann 3; Reiss Marrnott) and an increase in non electrolytes of the blood such as urea and uric acid (Marrnott MacKay and MacKay). There is little or no alteration in the concentration of electrolytes (Na K Mg Ca HPO₄ SO₄) except Cl which is considerably increased (Schiff 69 Keith and Whelan). The lactic acid content of the blood is often doubled (Hartmann 37 Clausen Schiff 69) while the ability of the liver to mobilize glycogen is decreased (Andrews) and there may be possibly as a consequence a slight increase in the ketone acids of the blood (Moore Marrnott). It should be pointed out that dehydration may be accompanied by a blood stream alkalosis (McIver and Gamble) (e.g. following persistent vomiting from a pyloric stenosis) but under these conditions

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The brain of a large dog weighs from 4 to 5 ounces. The gross appearance of the cerebrum and cerebellum is not markedly different from that of the human, the convolutions, however, are broader and less numerous. The cerebral hemispheres are very broad behind and diminish in width anteriorly, there is a sudden narrowing at the frontal lobes which are flattened laterally. The anterior end of the olfactory bulb projects beyond the frontal lobe. The hypophysis is circular and small, the pons is relatively small, the cerebellum is very broad, but is low and also compressed from before backward. The medulla oblongata is broad and thick. The pyramids are large and prominent.

The spinal cord is almost circular in cross section except at the well marked cervical and lumbar enlargements where it is compressed dorsoventrally. The spinal nerves are arranged in pairs,

8 cervical	13 thoracic
6 lumbar	5 sacral

The central canal is patent, in this respect differing from the majority of human cords and this must be considered when injecting anesthetics into the subdural space because of the ascent of the drug to the vital centers. There is approximately 20 to 25 cubic centimeters of spinal fluid in the subarachnoid space of a large dog.

While the preceding comparison is lacking in minor details and in accurate description of the finer anatomical points, it shows that the cerebrospinal system of the dog presents no gross dissimilarity to that of the human great enough to preclude its use in studying the effect of the action of various drugs injected into the cisterna and subarachnoid space. The difficulties encountered are technical and due to the morphology of the spinous processes and laminae. Successful spinal punctures are practically impossible without injuring the cord, or penetrating the central canal.

We have regularly performed laminectomies, with the exception of eight or ten experiments (200 dogs) to insure thorough mixing of anesthetic solution and spinal fluid and to decrease the possibility of traumatizing

the cord. We felt this gave us much greater security in the work we were attempting, although it prolonged pre-experimental procedures. Recently we have seen that H. Dvorak and M. H. Manson (3) have operated on dogs under spinal anesthesia with about 80 per cent successful injections, but in their preliminary work, they have not mentioned whether trauma was produced in the cord or not.

TECHNIQUE OF LAMINECTOMY AND SPINAL PUNCTURE IN THE DOG

The operative field is prepared in the usual way, the muscles are separated from the spinous processes, subperiosteally, the spinous processes are removed with bone cutting forceps, and a portion of the laminae with rongeur forceps. We have found that if an opening into the canal be made just large enough to insert a Cozzolini-Alport bone rongeur, the remainder of the operation is simple. At times one is annoyed by a small spurting vessel if considerable bone is removed laterally. This can usually be controlled by fixing a small piece of muscle against it. The dura is covered with a layer of areolar tissue which should be pushed aside with moist gauze. For injection, we use a needle slightly larger than the average hypodermic, which is bent 1 centimeter from the point to a 90 degree angle. The point is then resharpened. Even with these precautions, one may penetrate the cord and force the solution into the central canal.

TECHNIQUE OF CISTERNA PUNCTURE IN THE DOG

The technique of cisterna puncture in the dog is different from that in the human in that one cannot follow the receding occipital bone to the foramen magnum in the dog because of the projection of the occipital condyles. After experimenting with many positions and various types of technique, we have decided that the following is the simplest.

The animal is anesthetized, placed in a lateral prone position with the head slightly raised, the occiput is shaved and painted with tincture of iodine, the nose is held at right angles to the vertebral column. A point is selected in the midline 3 5

SPINAL ANÆSTHESIA

A SUMMARY OF CLINICAL AND EXPERIMENTAL INVESTIGATIONS WITH PRACTICAL DEDUCTIONS

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IN 1920 we observed that high anesthesia from the second to the fourth rib could be obtained in shocked patients when half the usual dose of stovaine was injected intraspinaly. This led us to study the cerebrospinal pressure of patients suffering with ruptured duodenal ulcer, acute pancreatitis, etc., and we found that the pressure was invariably reduced. We also observed that when patients became fearful and struggled during the injection we frequently failed to obtain anesthesia when the full adult dose was administered. In these patients the cerebrospinal pressure was of course increased. We felt that the diffusion of anesthetics injected intraspinaly when given in an upright position was intimately associated with the cerebrospinal pressure. These deductions were partially confirmed by clinical observations. By reducing the spinal pressure from that found to 10 millimeters of mercury we were able to obtain uniformly high anesthesia by injecting the full adult doses at the third lumbar interspace. The height could be varied by using the same dose at a different pressure—the higher the cerebrospinal pressure the lower the anesthesia. These deductions were confirmed by animal experimentation in 1922. In addition we noted that smaller amounts of the anesthetic solution at lower cerebrospinal pressures gave a shorter period of anesthesia but kept the region anesthetized below the fourth rib. Larger doses at higher pressures gave a more prolonged anesthesia at lower levels.

Our endeavors to control the height of anesthesia and degree of shock by using the same interspace and the same degree of mixing, varying the dose with the cerebrospinal pressure, were only partially successful however, and we concluded that factors other than those recognized up to that time were responsible for the physiologic changes following the giving of the intraspinal injection. That this

contention was correct is shown by the report of our experimental work which follows.

Experimental work was begun in 1922 under the direction of Dr J E Sweet then professor of surgical research at the University of Pennsylvania. From 1926 to 1930 experiments were conducted in the Department of Experimental Pathology at the same institution and in 1931 in the Department of Surgical Research, Temple University. We have operated on approximately 200 dogs and have always removed the brain and spinal cord at the completion of the experiment to determine the extent of the diffusion of the anesthetic, the possibility of needle punctures in medulla or cord, anesthetic in the central canal or hemorrhage. If any evidence of trauma was present the experiment was discarded.

Because of the lack of information in surgical literature on the morphology of the cranium and vertebrae and their contents in the lower animals we include a brief note on the comparative anatomy of man and the dog.

COMPARATIVE ANATOMY OF THE CEREBRO-SPINAL SYSTEMS OF MAN AND THE DOG

There is little difference between the protective covering of the brain and spinal cord in man and the dog. The thickness, extent, processes and attachments of the dura with one or two exceptions are identical. In the dog however the tentorium cerebelli is a crescentic fold occupying the transverse fissure between the cerebellum and the cerebral hemispheres and is reinforced by the tentorium osseum, a thin flat bony plate 1 millimeter in thickness attached to the dura anteriorly. The dura covering the spinal cord is the same as in the human; the subdural space is smaller, the cord approximating the dura. This is particularly true in the cervical and lumbar regions.

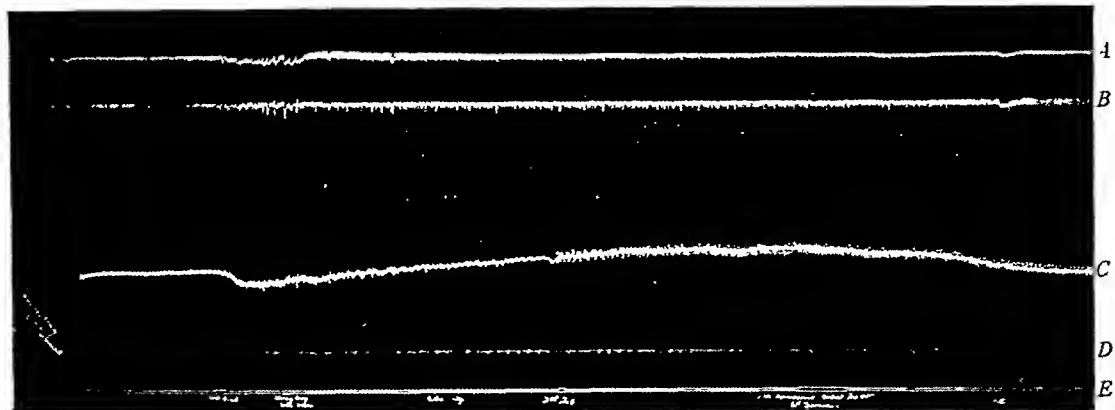
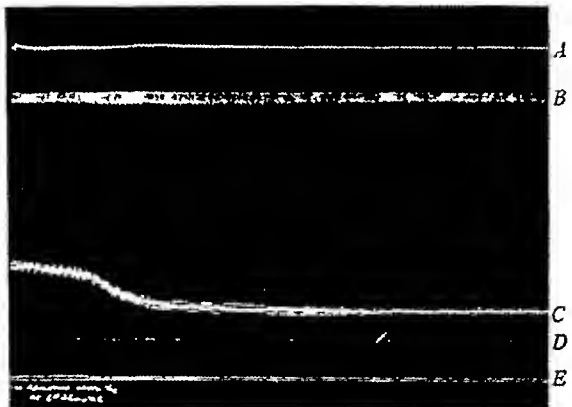


Fig 2 Effect of novocain strychnine solution on costal and abdominal respiration. Male, weight 19.4 kilograms. Laminectomy fifth to seventh thoracic, cord tied at sixth thoracic, 1 cubic centimeter novocain strychnine solution injected below tie, with very slight drop in blood pressure and slight diminution in amplitude of costal respiration. Later 1 cubic centimeter of same solution injected above tie produced marked drop in blood pressure with almost complete loss in costal tracing and a marked increase in amplitude of abdominal respiration. One half hour later costal and abdominal respiratory tracing returned to normal excursion as did blood pressure. Dye had reached faintly to fourth cervical. Evidently the amount of novocain contained in the solution was insufficient to paralyze completely the phrenic nerve roots. A, costal respiration, B, abdominal respiration, C, carotid blood pressure, D, time, 5 seconds, E, signal.



sions and opening of the system. There exists a valvular action in the course of the subarachnoid space.

The absorption of substances from the subarachnoid space is relatively rapid, for phenolsulphonephthalein introduced into the subarachnoid space can be detected in the urine in 25 minutes. Such absorption rate is entirely too slow, however, to produce an immediate fall in arterial pressure following the induction of spinal anaesthesia. However, to rule out the possible effect of the anaesthesia by way of the vascular system, through absorption from the subarachnoid space, intra-arterial and intravenous injection of stovaine solutions were made. Intra-arterial injection produced but a slight transitory fall in arterial pressure. Intravenous injection, on the other hand, caused a more pronounced and prolonged fall with recovery to the pre-injection level in about 8 minutes (Fig. 1) (See work in 1931). We felt that these facts ruled out a possible effect of the anaesthetic

solution by way of the vascular system through absorption from the subarachnoid space.

In attempting to determine the reason for the fall in arterial pressure, we made oncometric readings of the lower extremities of dogs under spinal anaesthesia with negative results, and concluded that a dilatation of the peripheral vessels was in no way associated with this distressing and at times alarming complication of spinal anaesthesia nor could we observe either blanching or hyperaemia of exposed portions of the intestinal tract supplied by the splanchnics.

Further by ligaturing the cord just above the origin of the splanchnics (sixth dorsal to second lumbar) we obtained evidence of splanchnic stimulation with hyperperistalsis, vomiting, etc., without any fall in arterial pressure. By doing two laminectomies and segmenting the cord with ligatures in the region

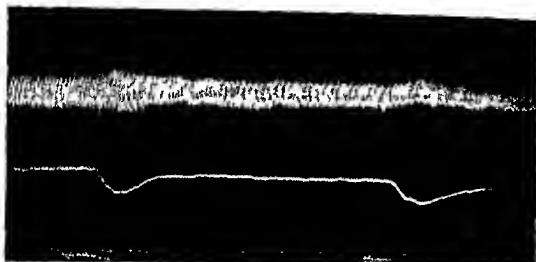


Fig. Eff. of the anesthetic solution by intracranial and intraspinal injection. Upper trace, myocardial graph; lower trace, spinal fluid pressure.

centimeter below the occipital protuberance. A No. 20 gauge spinal needle with the point slightly beveled is inserted at right angles for a distance of 1.5 centimeters. The stylet is withdrawn with the tips of the fingers; the needle is gradually inserted until cerebrospinal fluid appears. If either is being used as an anesthetic and the dog is a normal one, the spinal fluid will purt from the needle. We have rarely encountered hæmorrhage and aseptically always able to mix the anesthetic with the spinal fluid.

EXPERIMENTAL WORK DURING 1923-1925

In order to determine the height reached by the anesthetic solution on injection, rosanilin hydrochloride was added. This dye stained the dura mater quite definitely whenever it came in contact with it and diffused equally with the anesthetic solution. We determined this by doing a laminectomy under local anæsthesia giving spinal and then testing the cutaneous sensation by means of the galvanic current.

The spread of the anesthetic injected into the subarachnoid space is dependent upon (1) the existing pressure of the cerebrospinal fluid (2) the volume of solution injected (3) the degree of mechanical intermixing of the injected solution with the spinal fluid (4) the force with which the injection is made and (5) to a lesser degree the position of the patient. These factors are controllable and

from the experiments made we concluded that the diffusion of the anesthetic solution was inversely proportional to the cerebrospinal pressure, other factors being equal. Force of injection, volume of solution injected, position of the dog, etc.

A greater cerebrospinal fluid pressure exists at the cisterna magna than at the level of the third lumbar vertebra with the patient in the sitting position. This is true also in the dog. But if the patient lies on his side and a simultaneous cisterna and lumbar puncture be made and pressures taken it will be found that they are the same. This also holds true for the dog. Such being the case the cerebrospinal system must be hydrodynamic and not hydrostatic. The explanation probably lies in the anatomical construction of the subarachnoid space. We do not have a free cylinder as it were of cerebrospinal fluid about the cord for it is broken at regular intervals by the anterior and posterior roots coming out so that what we really have is an anterior and posterior column with a communication between the nerve roots and also at the cisterna magna. And with changing positions we have mechanical occlu-

By means of long glass cylinder, rubber tubing and rubber bag to pressure and of barometer to measure pressure, the cerebrospinal fluid was demonstrated mechanically at the meeting of the American Society for the Study of Anæsthesia, New York City, 1925.

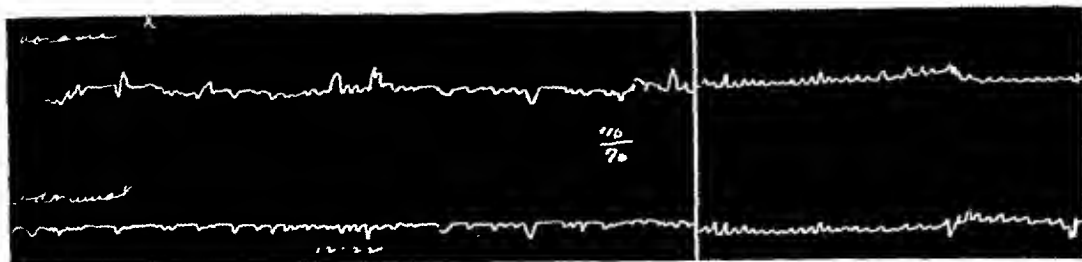


Fig 5 Effect of low spinal, eighth thoracic, in human on costal and abdominal respiration. Upper tracing costal, lower abdominal. Tracing at left, shortly after injection of stovaine, at right, 30 minutes later, neither showing any change in respiratory excursion

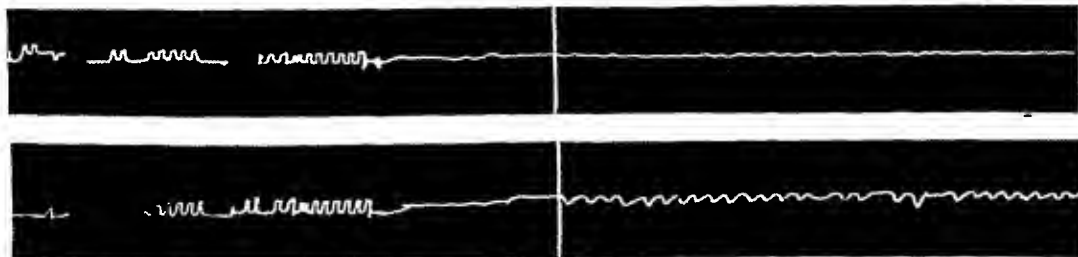


Fig 6 Effect of high spinal, fourth thoracic, in human on costal and abdominal respiration. Insertion of radium for carcinoma of cervix. Upper tracing costal, lower abdominal. Tracing at left, before injection of stovaine, at right, after injection of stovaine with complete loss of costal respiratory excursions

proved to cause a drop in blood pressure if injected high enough, caused no change in either respiratory tracings or arterial pressure. Stovaine injected in the thoracic region would paralyze the intercostal nerves and although there would be an immediate impairment and rapid loss of all respiratory movements of the chest wall and thoracic tracing, together with a marked fall in arterial pressure, abdominal respiration would still persist unimpaired. If, however, stovaine were injected high in the thoracic cord so that it diffused both low enough to paralyze the intercostals and high enough to paralyze the phrenic nerves, and consequently the diaphragm, then there would be almost immediate cessation of all respiratory movements, costal and abdominal (diaphragmatic) and a more marked fall in arterial pressure (Fig 3).

If the anæsthetic solution had not paralyzed the medullary centers, then there would be a slight asphyxial rise in blood pressure after the original marked drop due to stimulation of the vasomotor centers by the circulating carbon dioxide. When the center became

fatigued the blood pressure fell and the dog died. If however, artificial respiration were employed before the center tired, the animal could be kept alive until voluntary respiration returned provided artificial respiration was instituted soon enough. Repeated experiments confirmed this.

If cisternal puncture was used for injecting the anæsthetic, then we would have an immediate asphyxial rise in arterial pressure, unless the drug employed was too toxic for the vasomotor center. If artificial respiration was not used, the animal would die, but by artificial respiration alone, we could invariably keep the dogs alive until voluntary respiration returned (Fig 4).

These experiments convinced us that the most important danger signal in spinal anæsthesia was embarrassment in respiration and that the alarming drop in blood pressure, which was being watched so closely clinically, was of secondary importance.

With this fact in mind we followed several patients to the operating room and made thoracic and abdominal tracings in exactly the same manner as in our experimental work.

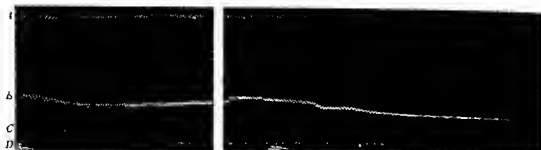


Fig 3 N oca try h n i t —en t f h g p ssur T o b e i met sa sol t also
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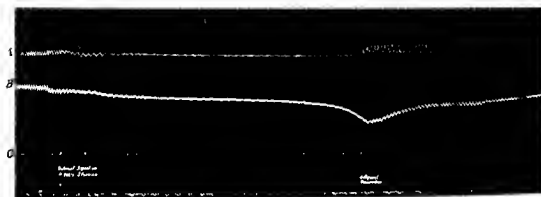


Fig 4 St sol u N j—e t al j t n m t h l p u v l t ry p t twn d b
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 G d l fill t nal p with ec ry d

of the fifth thoracic and first lumbar and then injecting stoveaine solution we could till not demonstrate to our satisfaction that the splanchnics were operative in the fall of arterial pressure. For by tying the ligature in the first lumbar segment sufficiently snug to obliterate the subarachnoid space and then injecting stoveaine below no fall in blood pressure was recorded. Obliterating the subarachnoid space at the level of the fifth thoracic by the same means and injecting the stoveaine into the upper thoracic region of the cord above the fifth thoracic segment we obtained a much greater fall in blood pressure with an immediate effect on respiration (Fig. 2). While we realized these two findings were not conclusive evidence against a vasodilata-

tion of the splanchnic area being concerned in the fall in arterial pressure other significant findings claimed our attention (1).

We realized by now that respiratory embarrassment was intimately associated with the fall in blood pressure and subsequent experiments confirmed this very conclusively. We made simultaneous tracings of carotid arterial pressure by means of a mercury manometer and of respiration by placing pneumographs around the chest and abdomen in connection with recording tambours for the total and diaphragmatic respiratory movements respectively. By ligating and segmenting the cord as described we could demonstrate this very definitely. Stoveaine injected below the thoracic cord in amounts previously

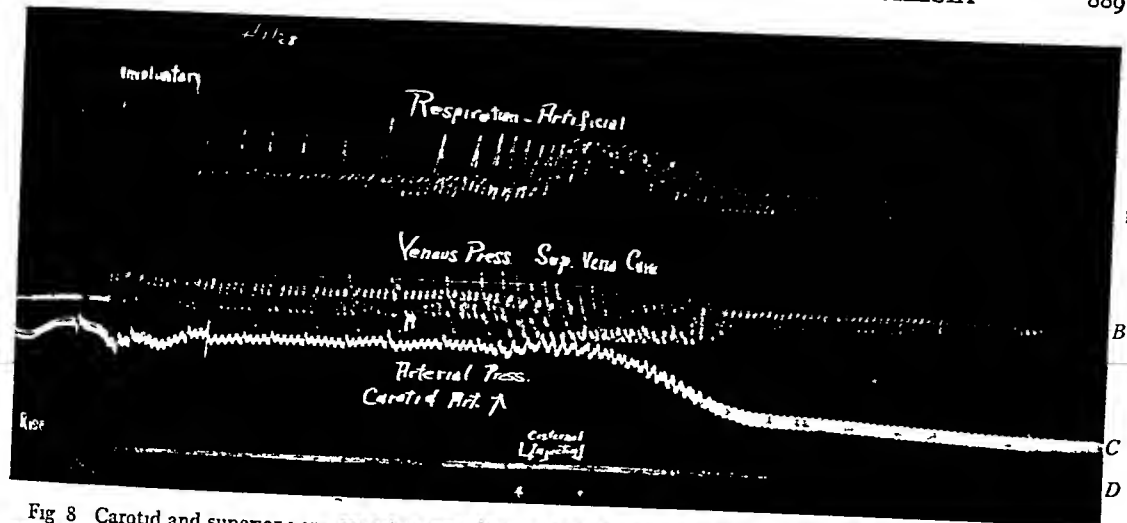


Fig 8 Carotid and superior vena cava tracings showing rise in pressure in superior vena cava during fall in arterial pressure April 1, 1928 Male dog, 10 kilograms, ether anaesthesia. Cisternal injection 2 cubic centimeters stovaine solution No 1 Tracing shows an immediate fall in carotid blood pressure and rise in superior caval pressure, autopsy showed absence of blood in cisterna and no injury to medulla. A, Respiration tracing, B, superior vena cava tracing, C, carotid tracing, D, time (5 seconds)

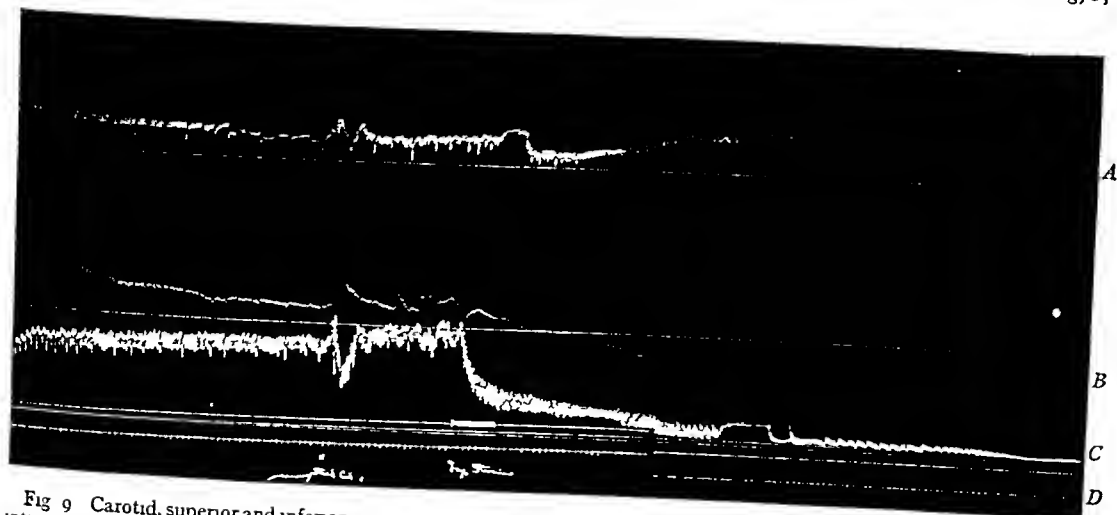


Fig 9 Carotid, superior and inferior vena cava tracings showing rise in pressure in superior and fall in inferior following intraspinal injection of stovaine Decerebrate dog Laminectomy, eighth, ninth, tenth thoracic. Injection 1 cubic centimeter stovaine solution No 1 Immediate fall in arterial and inferior caval pressure associated with a rise in superior caval pressure Autopsy showed dye had ascended to fourth cervical and had not penetrated the central canal 4, Superior vena cava tracing, citrate medium, bellows recorder, B, inferior vena cava tracing, citrate medium, tambour recorder, C, carotid tracing (Hg), D, time (5 seconds)

slight fall in blood pressure (Fig 5), but if the anaesthesia reached the second rib, there was almost a complete cessation of costal respiration (with maintenance of diaphragmatic and abdominal) and a greater fall in blood pressure (Fig 6) Very slight and very occa-

sional excursions could be seen in the costal tracing, usually in association with larger excursions in the abdominal tracing, and we thought these were reflections from the lower ribs from the attachment of the diaphragm (2)

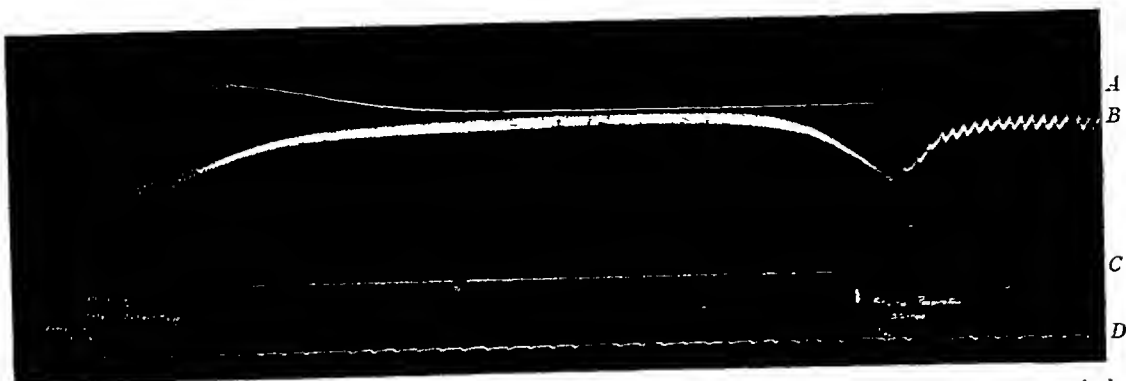


Fig 11 Novocain strychnine solution—cisternal injection Female, weight 9 kilograms Cisternal injection of 2 cubic centimeters of novocain strychnine solution Respiration ceased 40 seconds after injection, gradual rise of arterial pressure, after injection, persisting for 3 minutes Voluntary respiration returned 12 minutes after artificial respiration was begun, or 18 minutes after injection Voluntary movements returned in 19 minutes A, Thoracic respiration, B, arterial pressure (carotid), C, signal, D, time intervals (5 seconds)



Fig 12 Neocaine cisternal injection October 1, 1930 Female, weight 9 kilograms Cisternal injection of 2 cubic centimeters of neocaine No cessation but diminution in amplitude of respiration, returning to normal excursion about 3 minutes after injection Permanent rise in arterial pressure after injection A, thoracic respiration, B, arterial pressure (carotid), C, signal, D, time intervals (5 seconds)

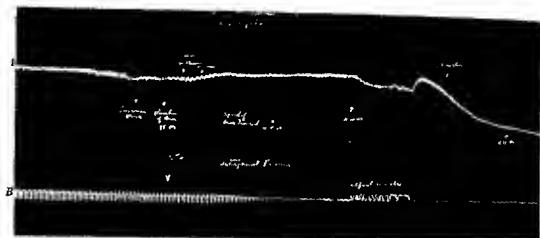
tracings in conjunction with pneumographs, but also by using a Jackson's intrapleural cannula (Fig 10)

EXPERIMENTAL WORK DURING 1930

Between the years 1927-1930 there had been a noticeable increase in the use of spinal anesthesia, in hospitals in which it had seldom been used before There were many more anæsthetic solutions on the market and different commercial houses were preparing the same drug, some in ampule form and others in crystalline form Further, it had been noticed that indifferent and at times unreliable results were being obtained from the same drug supplied by different firms, and lastly, deaths had occurred in the hands of skilled spinal anæsthetists who had had many years' experience

with this type of anæsthesia This may have been due in part to the enthusiasm of certain firms in advertising anæsthetic solutions and special formulas without adequate preliminary experimental investigations These facts led us to study, in the fall of 1930, the action of different anæsthetic solutions

We attempted to gauge the relative potency and toxicity of several commercial anæsthetic solutions by using the full amount of the drug contained in the ampule and timing the disappearance of all respiratory movements and the period of artificial respiration required before voluntary respiration was resumed We realized that this would not be recognized as a valid pharmacological assay, because different solutions contained more drug per cubic centimeter, but it would give a relative



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EXPERIMENTAL WORK DURING 1926-1928

The most alarming feature of spinal anesthesia is the fall in arterial pressure and in our experimental work we consistently failed to obtain a fall in blood pressure unless a sufficient number of intercostal nerves had been anesthetized to embarrass the thoracic respiration. Usually though not invariably respiratory embarrassment preceded the fall in arterial pressure.

To determine the reason for this associated fall in arterial pressure we made simultaneous arterial and venous pressure tracings from both inferior and superior vena cava. Suitably bent and paraffined glass tubes were placed up the lumen of the femoral and iliac veins to the inferior vena cava and down the external jugular vein to a point just below the valves. These were connected by pressure tubing with a Brodie's bellows with the interposition of a column of air between the bellows and the citrate solution in the glass tubes. This allowed us to record on the kymograph drum all fluctuation of pressure within each cava. We found that an increase of pressure within the inferior vena cava did not accompany the most profound fall in general arterial pressure and we took this to be presumptive evidence that splanchnic dilatation was not responsible for the fall in blood pressure. On

the other hand simultaneous with the embarrassment of respiration and fall in arterial pressure there occurred an alteration in the pressure within the superior vena cava (Figs. 7, 8, 9). The venous pressure within this great cistern tended to rise and approach zero or atmospheric pressure as respiration diminished and as the respiratory embarrassment continued to complete cessation the superior caval pressure became progressively more and more positive although the heart continued to beat quite forcibly.

We considered the following as a possible explanation for this. The pooling of blood in the lungs with failure of the left heart to obtain an adequate volume of blood because of the absence of the pulmonary lung action. Such a phenomenon if existing would dam back the venous blood into the right heart and the great vessels of the chest producing in them an increase of both blood volume and blood pressure.

We realized that these possible explanations were opposed to the current concept of the physiology of the heart lung blood flow mechanism but were further influenced by noting that the rising pressure in the superior vena cava after the induction of spinal anesthesia could be decreased by artificial respiration. This was confirmed not only by venous

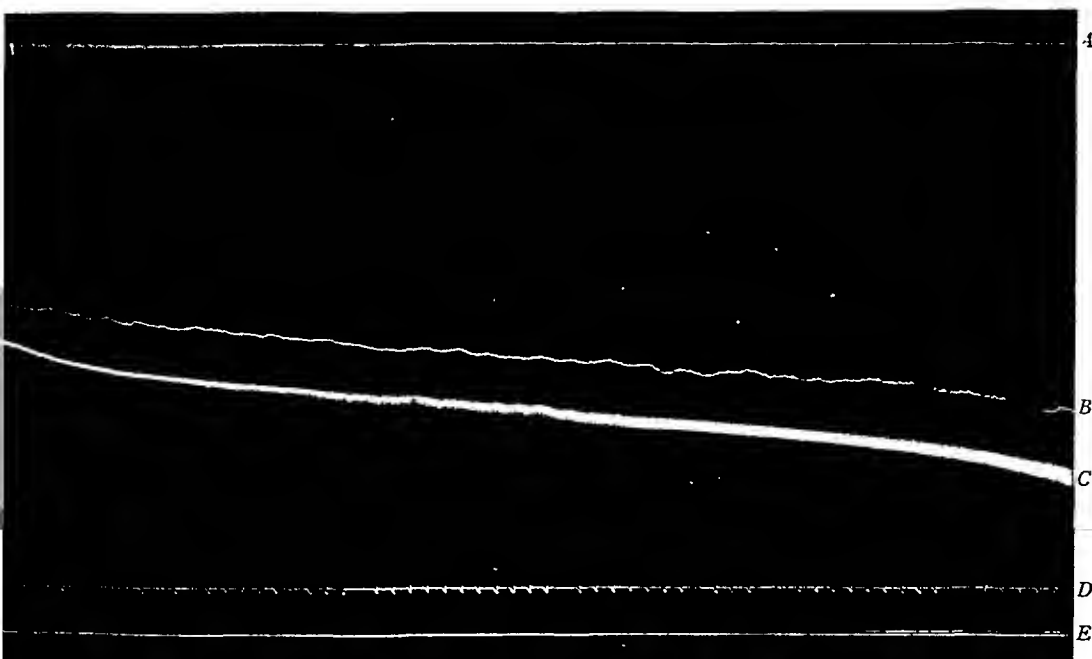


Fig 14 Plethysmograph tracing showing decrease of intestinal volume following intraspinal injection of stovaine and subcutaneous injection of ephedrin. Dog, weight 15.3 kilograms. Laminectomy, fifth to seventh dorsal. Ephedrin $\frac{3}{4}$ gm given subcutaneously 8 minutes before stovaine. 0.8 gram stovaine No. 2. Gradual fall in arterial pressure and volume of ileum, respirations decreased in amplitude and almost stopped. Second injection of ephedrin given 6 minutes after stovaine. Artificial respiration started, blood pressure rose, also plethysmograph, voluntary respiration resumed in 12 minutes. Dye reached to the second cervical. 4, respiration, B, plethysmograph (ileum), C, carotid, D, time (5 seconds), E, signal.

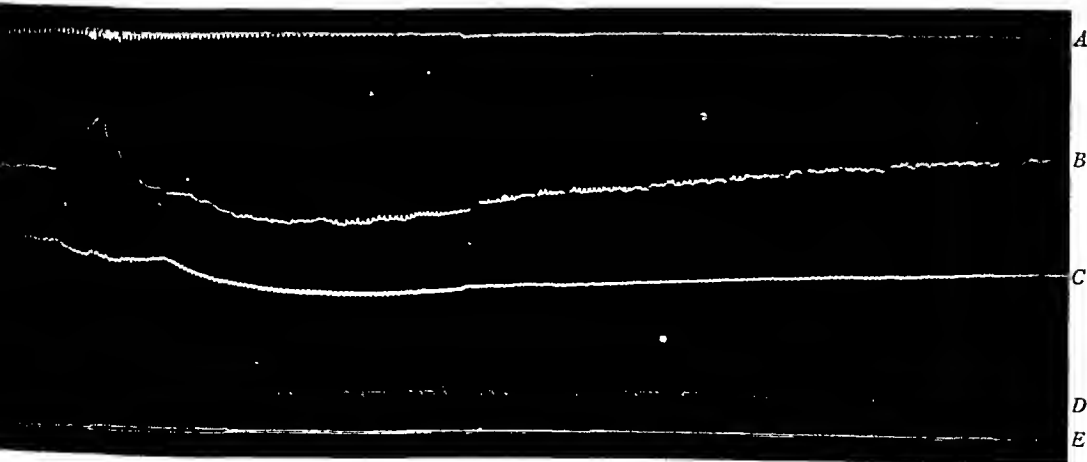


Fig 15 Plethysmograph tracing showing no change in volume of intestine following intraspinal injection of stovaine April 27, 1931. Male dog, 11.2 kilograms, ether anesthesia laminectomy eleventh thoracic to second lumbar—15 centimeters loop of ileum placed in Livingston's oncometer—injection 2 cubic centimeters stovaine solution No. 3. Slight fall in blood pressure with practically no change in volume of ileum. Diminution in amplitude of respiration but recovery without artificial means. Dye ascended to seventh cervical—autopsy showed that dye had not penetrated central canal. 4, respiration, B, plethysmograph (ileum), C, carotid, D, time (5 seconds), E, signal.

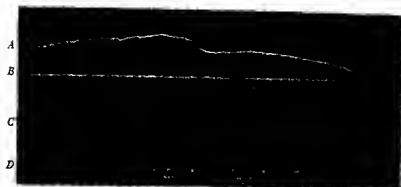


Fig. 3. Plethysmographic blood pressure tracings showing effect of spinal anesthesia on plethysmographic blood pressure. Laminectomy sixth to eighth thoracic cord level. Plethysmographic blood pressure in the abdominal aorta and carotid artery. A, before anesthesia; B, during anesthesia; C, after anesthesia; D, after anesthesia.

indication from the standpoint of their action on respiration which is the greatest danger in spinal anesthesia. The full 2 cubic centimeters of anesthetic solution were given with sufficient rosanilin hydrochloride added to stain the dura and these were all administered by the cisternal route. We had previously determined that an equivalent amount of salt solution or other inert fluid would cause but transitory changes in either blood pressure or respiration no more in fact than would be caused by simple cisternal puncture. We chose the cisternal route because we wished to get the most rapid and toxic effect possible on the respiratory center and nerves governing respiratory movements.

In general we found that artificial respiration was the most efficient method of resuscitation and the only stimulation necessary to effect recovery provided it was begun before the respiratory center had ceased to function and was kept up long enough. Measuring the toxicity and potency of the drugs employed by the rapidity of loss of respiration and length of time necessary for recovery with artificial respiration we found that they ranged themselves in the following sequence: Butyn, stovaine (different commercial preparations), nupercaine, spinocaine, apothesine, novocain (different commercial preparations) and least toxic, neocaine (Figs. 11 and 12).

EXPERIMENTAL WORK DURING 1931

In the late summer or early fall of 1930 Drs. Ferguson and North (4) working in Dr. I. S. Ravdin's laboratory had excised the splanchnic ganglia in dogs and after recovery had induced spinal anesthesia with no different results in arterial pressure findings than occurred in dogs with intact splanchnic ganglia. This confirmed our previous statements of 1925 and 1928 based on the active finding. We again confirmed these findings in 1931 by the plethysmographic tracings of dogs' livers and portions of the ileum using Livingston's oncometer (Figs. 13, 14 and 15). In no experiment could we demonstrate a constant increase in volume of the contained organ which would have happened had splanchnic dilatation occurred.

In discussing the problem with Dr. Livingston he suggested the use of myocardiographic tracings on the exposed heart since most of our data pointed toward intrathoracic conditions being chiefly concerned with the marked fall in arterial pressure.

We have performed myocardiographic tracings on the exposed heart of dogs in conjunction with arterial carotid tracings and have been able to demonstrate in all experiments to date that the fall in arterial pressure following the intraspinal injection of the commonly used anesthetics—stovaine, novocain, etc.—is asso-

DRUG PARALYSIS OF CARDIAC AND RESPIRATORY NERVES

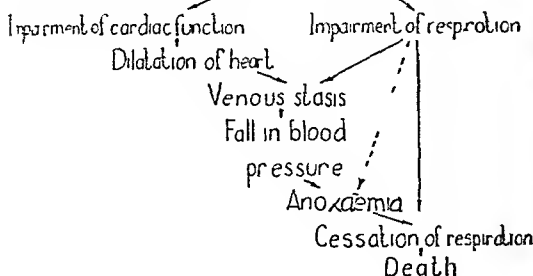


Table I

5 If no artificial means of stimulation are resorted to, and artificial respiration is all that is necessary, voluntary respiration will cease entirely and the dog will die (Table I)

The sequence of the events as outlined presupposes that the anæsthetic drug has reached the level of the cord supplying cardiac and respiratory nerves. Should the drug not affect the cardiac nerves directly, but only impair respiration, then the sequence of events would be (1) impairment of respiration, (2) venous stasis, (3) fall in arterial pressure, (4) anoxæmia, with its resultant effect on all factors mentioned until the paralytic effect of the drug begins to wear off. In other words, a vicious circle is established and continued as long as the drug acts on the motor respiratory nerves.

To determine the efficiency of the Drinker respirator in treating patients suffering with respiratory failure following spinal anæsthesia and to observe the sucking action of the negative pressure chamber on viscera through an abdominal incision, the following experiments were conducted:

March 18, 1931 *Dog No 66* Male, white collie, weight 25 kilograms, Philadelphia General Hospital. Cisterna injection 0.8 stovaine lactic acid, 0.8, alcohol, 0.2, distilled water to make 2 cubic centimeters, solution colored with aniline dye.

The spinal fluid was clear, the anæsthetic solution was well mixed, requiring 18 seconds. There was an immediate paralysis, with diminution of amplitude of respiration. At the end of 2 minutes, respiration had ceased, the animal was placed in the Drinker apparatus and artificial respiration started. Normal excursions were obtained at 20 millimeters pressure. Forty minutes after the injection the animal moved the right masseter muscle. The res-

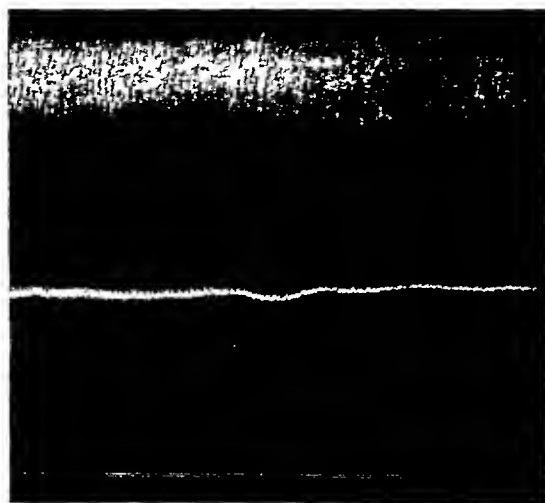


Fig 17 Continuation of myocardiographic tracing shown in Figure 16, 20 minutes after injection of stovaine. Compare amplitude of excursions of the myocardiograph with those of Figure 16.

pirator was stopped and the animal resumed normal respirations. Fifty-seven minutes after the injection the animal voluntarily moved the right forepaw. Shortly after this he was taken out of the respirator. A right midrectus incision was made and a 20 centimeter loop of ileum was placed outside the rectus muscle. The animal was returned to the respirator, but artificial respiration resumed by the negative pressure had no effect on the position of the ileum. The dog was killed with ether.

Postmortem examination showed that there was no hæmorrhage into the cisterna, the dye had penetrated to the second cervical, and anteriorly to the mammillary bodies.

April 18, 1931 *Dog No 84* Female, weight 22.7 kilograms, aseptic procedure throughout. Anæsthetic 0.8 stovaine (Babcock's solution) without dye. Cisterna injection 9 03 a.m., cerebrospinal fluid clear—mixing time 25 seconds, 9 04 a.m., placed in Drinker respirator, 9 09 a.m., ocular reflexes absent, respirations ceased, 9 10 a.m., respirator started, 9 11, lingual artery not pulsating, 9 12, pulsation in lingual artery returned, 9 20, voluntary respirations returned—animal removed from respirator, 9 31 animal moved forepaws, 10 20, stood on all fours and walked about cage. April 25, 1931, animal in good condition.

These experiments show that the Drinker respirator is a valuable adjunct in combating respiratory failure induced by spinal anæsthesia and that the negative pressure in the cabinet is not sufficient to eviscerate a subject with an open abdominal wound.

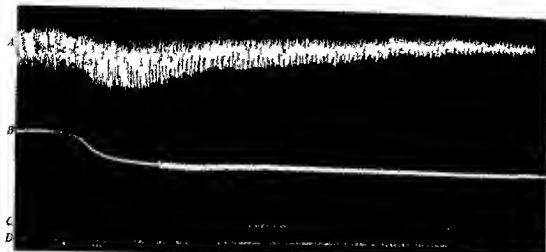


Fig 6 Myocardiographic tracing showing a sharp drop in amplitude followed by a gradual recovery. The tracing is labeled with 'A' at the top, 'B' on the left, and 'C' at the bottom. The signal is highly irregular and noisy, typical of early electrocardiographic recordings.

ciated with a dilatation of the entire heart more particularly the right ventricle a relaxation of heart muscle and decrease in force of the contraction. This latter appears within about 2 minutes with the drugs used so far almost simultaneous with the relaxation and dilatation of the heart (Fig 16). Moving pictures of this phenomenon have been obtained and show what happens quite dramatically. There is a gradual recovery of the tone of the heart muscle and force of contraction and the original pre injection condition of the heart is obtained in from 20 to 45 minutes depending upon the drug used and the height of the anæsthetic provided there is no previous myocardial damage (Fig 17). In one dog used there was almost immediate extreme dilatation of the heart with death in about 20 minutes. Histological examination of both right and left ventricle showed definite evidence of a subacute myocarditis with localized areas of cellular infiltration in the interstitial tissue.

In all fairness we must state that in these dogs with myocardiographic tracings it was necessary to use artificial respiration throughout the experiment because thus far we have been unable to expose the heart without opening the pleural cavity. There is no assistance

from the intrapulmonary and intrathoracic pressure because neither the heart is beating nor the lungs expanding in a closed space. However under artificial respiration and with the heart exposed myocardiographic tracings can be made over a period of hours with no change in the cardiac contractions or tonicity of the heart muscle. We feel therefore that the opening of the thorax under artificial respiration and simple exposure of the heart cannot be responsible for the dilatation noted.

Further studies along this line are being continued different anæsthetic solutions and ephedrin being used to help maintain arterial pressure and will be reported subsequently.

The results of our experimental work to date have led us to formulate the following course of events as a probable *modus operandi* in death in the pinal anæsthesia.

1. A drug paralysis of cardiac and respiratory nerves leading to

2. Dilatation of the heart and respiratory embarrassment

3. Cardiac dilatation permits venous stasis and fall in arterial pressure the former being aided by the respiratory impairment

4. Anoxæmia is caused by the fall in arterial pressure and diminished respiration which also aids in venous stasis

surgeon at a glance the depth of the patient's respirations. If they have diminished he reminds the anæsthetist to instruct the patient to perform deep breathing. If voluntary forced inspiration cannot be accomplished by the patient, then forced inspiration should be carried out or the patient placed in a Drinker respirator. Any of these procedures combats collapse by increasing intrapulmonary and intrathoracic pressure, preventing overdistention of the large venous channels and assisting the heart to empty by pressure from the distended lungs. One of the most unpleasant features following spinal anæsthesia from a subjective standpoint is the inability to breathe, and is responsible for the fear of impending death which some have experienced. This anoxæmia has a decided effect on the respiratory center and the oxygenation of the heart muscle. There can be no objection to the use of adrenalin or ephedrin. As previously stated, however, neither of these drugs has prevented cardiac dilatation nor relieved respiratory embarrassment in our experimental work. In sudden collapse the intravenous injection of adrenalin should be used in addition to forced inspiration. In animals where the respirator has been used within a minute after complete cessation of respiration stimulants have not been necessary.

SUMMARY OF EXPERIMENTAL WORK

1 The fall in blood pressure following the injection of an anæsthetic into the subarachnoid space is not due to a collection of blood in the splanchnic area.

2 When the anæsthetic ascends to the fourth thoracic nerve roots or higher in the dog there is an associated dilatation of the heart.

3 The marked fall in blood pressure is mainly cardiac. Paralysis of the intercostal and phrenic nerves interfere with normal chest expansion and diaphragmatic excursion causing a damming back of venous blood in the right heart and its tributaries. When the

ascent of the anæsthetic in the spinal canal is gradual, the blood pressure drops gradually and reaches its minimum in from 15 to 20 minutes. When the anæsthetic ascends rapidly and sufficiently high to affect not only the nerves of respiration but the respiratory and vasomotor centers, the fall in arterial pressure is almost immediate but may be preceded by an asphyxial rise.

4 Sudden deaths following intraspinal injections may be cardiac, cardiac and respiratory, or respiratory.

5 Adrenalin and ephedrin have not prevented cardiac dilatation in our experiments.

6 The Drinker respirator alone will resuscitate an animal that has received the full adult dose of a spinal anæsthetic into the cisterna.

CONCLUSIONS

Practical application of experimental work to clinical usage.

1 Selection of the patient and an early recognition of a high effect are most important from the standpoint of the prevention of deaths.

a The foregoing outline we believe should assist in selecting patients for spinal anæsthesia.

b A respirometer should be used to determine early changes in respiratory volume following spinal anæsthesia.

2 Safe anæsthesia is the preservation of epicritic and protopathic sensation about the level of the sixth rib. Above this cardiac and respiratory embarrassment may develop.

3 Up to the present time there is no known method of absolutely preventing deaths from spinal anæsthesia, but artificial respiration offers the best means for combating respiratory embarrassment and the fall in arterial pressure.

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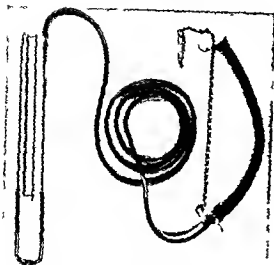


Fig. 8. Respirometer and ordinary U-tube filled with distilled water connected to pneumograph placed below the heart.

CLINICAL ASPECTS OF SPINAL ANÆSTHESIA

The risk associated with spinal anæsthesia has never been fully recognized because of a misinterpretation of the true cause of the drop in blood pressure and a lack of appreciation of the early effects of the intraspinal anæsthetic on the nerves of respiration. This has interfered with the placing of spinal anæsthesia in its proper category when compared with other anæsthetics. We have always known that the extent of upward diffusion determines the degree of shock. As in ordinary shock the blood pressure falls the skin becomes pale the respiration shallow but no one has written of having seen a suffused or congested intestine during a laparotomy under spinal anæsthesia. Shock is found in those cases in which the anæsthetic ascends higher than the uppermost origin of the splanchnics.

The knowledge that cardiac dilatation with thoracic stagnation of blood may be an accompaniment of spinal anæsthesia makes it possible for us to understand more clearly the catastrophes that have occurred in the past and to outline a routine to follow for selecting and protecting patients in the future who are candidates for spinal anæsthesia (Table II).

We still believe that there is a great deal to learn about the heart and its functional

TABLE II—OUTLINE FOR REDUCING ANÆSTHETIC RISK IN SPINAL ANÆSTHESIA

I. Selection of patients—

- Eliminate if myocardial lesion most important
- Circulatory disturbance if any of the following:
 - 1. Pre-existing heart disease
 - 2. Acute or chronic heart failure
 - 3. High diastolic pressure
 - 4. Electrocardiograph tracing positive for myocardial disease

II. Development of technique—

- 1. Anæsthetic technique
- 2. First dose and subsequent doses
- 3. Facility with drug
- 4. Selection of patient

III. Selection of drug—

Least toxic

IV. Early detection of high effect—

- 1. Arterial pressure should begin to fall within 15 minutes after patient is affected

capacity. No outline can in any way take the place of experience but we believe that it will help those contemplating using spinal anæsthesia to avoid the catastrophes which are not uncommon in one's early experience. The proper evaluation of the risk is most important but some patients will react unfavorably under spinal anæsthesia on the operating table. This happens where the myocardial damage has been of such a character that it escapes preoperative detection. In this type of case especially it is essential that high effect be recognized early and we advise the use of the respirometer for this purpose (Fig. 18). While cutaneous anæsthesia will help us to determine the height of anæsthesia unless the anæsthetist is especially trained in taking care of these patients she will not make repeated examinations. The surgeon is in part responsible because of his failure to insist on repeated examinations and there are occasions when the anæsthetist attempts to make observations but the upper level of the anæsthesia may be in the operative field. It must be remembered however that the first level of anæsthesia is not final as determined by cutaneous sensation but that usually there is a gradual ascent. We have had cases of delayed anæsthesia in which the anæsthetic ascended to a high level. This we cannot satisfactorily explain. The respirometer indicates to the

It is difficult to tell whether the migratory phlebitis, which is so often the concomitant of thrombo-angitis obliterans, is an independent disease or closely connected with the usual type of migratory phlebitis as seen

4 *Thrombophlebitis* It is this type, in which the thrombosis is the predominating factor and the phlebitis a secondary one, that is frequently unrecognized clinically and often results in sudden death from pulmonary embolism. It is in reference to this particular type that we have devoted our biochemical studies

PHYSICAL FORCES

It would seem advisable to enter into a philosophical discussion of the physical forces of postoperative thrombosis and thrombophlebitis and to attempt to derive therefrom a prophylactic policy. Analytical reports from surgical clinics tend to show that these conditions are more prevalent following operations upon the abdomen and in fat people, and rarely do they occur following operations on the brain and skull. One may ask why this should be, for many large veins must be traumatized in skull operations. I venture to suggest the following factors occurring in their etiology

a In abdominal cases, in which the surgical approach has been through the abdominal wall, there is constant motion in the field of repair during the first 48 hours, in operations on the skull, with the rigid skull cap, the field is kept at rest. With every breath taken and with the usual postoperative nausea and vomiting there is a constant thrust and pull on the operative field, which might easily dislodge a thrombus or cause its extension into a larger vein

b The approach for an abdominal operation is through an area of subcutaneous fat, while in skull operations there is a relatively small amount of fat. With the insertion of sutures, often under too great tension, and with the application of a tight abdominal dressing, necrosis of the traumatized fat may result. Experimentally we have found in dogs that if fat is taken from the subcutaneous tissues or the omentum and ground up with a small amount of saline in a mortar, the resultant fluid contains approximately 2

to 4 per cent fat. When this emulsion is injected intravenously or intraperitoneally a marked rise in the blood clotting index is produced. The description of this index is given later in the article

c Slowing of the blood stream. Since Welch's classical discussion of thrombosis and embolism in Albutt's *System of Medicine* almost all pathologists and surgeons have accredited the slowing of the blood stream as one of the primary factors in the production of thrombosis. It has been shown that thrombosis rarely occurs in arteries because the circulation of the blood is too rapid. Experiments have been performed in which formalin-prepared arterial segments were inserted in arterial defects without subsequent thrombus formation. Pathological specimens of aneurisms have shown that thrombosis occurs in the portions in which there are eddies, but in cases in which a dissecting aneurism has allowed a rapid flow of blood, thrombosis has not occurred.

Following abdominal operations it has been an almost universal practice to apply tight surgical dressings. The distention which usually follows within 24 hours after operation causes a marked increase in intra-abdominal pressure. If we consider that the return flow of blood in the vena cava is largely due to the suction of the heart and the respiratory movements, this increased abdominal pressure and splinting of the diaphragm must cause considerable stasis in the veins of the lower extremities. Moreover, with the almost universal use of the Gatch bed and the Fowler position, we have the double factors of gravity and constriction in the region of Poupart's ligament increased by the flexion of the thighs and by the lower border of the tight dressings.

d Infection. Infection or the presence of bacteria or their by-products in the blood stream is generally advanced as another contributing factor in the production of thrombophlebitis and thrombosis. These complications may occur in cases in which, to all apparent gross observation, the operative wound has healed *per primam*. We know that bacteria enter the blood stream through the intestinal walls. With postoperative dis-

POSTOPERATIVE THROMBOSIS THROMBOPHLEBITIS AND EMBOLISM¹

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EVERY surgeon before undertaking an operation of election has either a sub-conscious or conscious dread that an embolus may suddenly cause the exodus of his patient at a time when least expected. Until recently attempts to solve this problem have been concentrated largely on statistical reports. While these reports have shown us the types of patient and the types of lesion which are most prone to result in embolism they have not given any real light on the etiology or prophylaxis of these catastrophes.

At the Fifth Avenue Hospital during the past 4 years we have made a concerted study of postoperative thrombosis, thrombophlebitis and embolism. We have attempted to study the etiology to see if we could adapt therefrom a prophylactic policy. In order to study this problem we have arbitrarily divided the cases into two groups: (1) those caused by physical forces and (2) those caused by biochemical factors.

It is generally accepted that trauma, infection, slowing of the blood stream and dehydration predispose toward thrombosis. We have classified these as the physical forces. While we admit that infection is not of itself physical, nevertheless it is originated by the physical forces of the original injury or the trauma from operation.

We have felt, however, that there must be another factor inherent in the individual of a biochemical nature which would tend to make that individual more susceptible to thrombosis and embolism. This belief is based on the fact that many patients have all the physical forces present and yet do not develop thrombosis while others with a minimum number readily succumb.

We propose to discuss the physical forces which are concerned in the etiology and the practical measures which have been used in the treatment of operative cases and which in our hands have diminished the incidence of embolism. We also propose to discuss

rather in detail our studies on the clotting factors of blood, our experimental and clinical results from this analysis and to suggest certain lines of treatment which we have found diminish clotting tendencies after operation.

During the past 4 years in which we have been studying thrombosis and thrombophlebitis we have had an opportunity to see a large number of these cases because the various hospitals in New York have been good enough to allow us to study their clinical material.

Phlebitis and thrombophlebitis may be grouped clinically as follows:

1. *Septic phlebitis*. This is a manifestation of a general bacteremia usually accompanied by septic infarcts in various parts of the body. As this is a manifestation of a general systemic infection it will not be discussed in this article.

2. *Phlebitis and periphlebitis*. This type as generally seen after operation is characterized by a sharp elevation of temperature which may persist from 5 to 15 days. This rise in temperature is often inaugurated by a chill and is associated with pain and swelling of the extremities. It is probable that the associated periphlebitis and lymphangitis are largely responsible for the swelling of the limb. Homans has shown that in trying to reproduce this condition experimentally ligation of the femoral vein does not cause the swelling but if the adjacent lymphatics in the region of Poupart's ligament are obstructed the cold swollen leg results which we are accustomed to associate with phlebitis. As this disease is noted early in its onset and as appropriate measures are instituted to put the limb at rest, embolism is not a frequent complication.

3. *Migratory phlebitis*. This is a disease of rather unknown pathology and etiology. It is unquestionably bacterial in origin and may persist with intermissions over a period of years. Various veins may become affected

dissociated by extraneous forces, is a single complex in equilibrium, rather than a mixture of substances. The initial views of Harvey (1633) and of Woodbridge (1886) have come again into their own—"blood plasma is protoplasm and clotting is the last act of living blood."

When blood is shed, the plasma dissociates into substances which yield a clot. During the latent period of dissociation antithrombin is precipitated and prothrombin is activated by calcium ions. The resulting thrombin gels soluble fibrinogen into insoluble fibrin.

It has long been recognized that a clot can be started by throwing out to the periphery the blood platelets when the circulation is slowed down. As these blood platelets clump along some portion of the vessel walls, there takes place a coagulation, forming a red clot around the nucleus of platelets. The great question which comes up is whether this formation of clot can take place with only a slowing of the circulation or trauma, or whether there must be first a change in the blood clotting elements of the blood. Some writers feel that mild damage to the liver stimulates fibrinogen formation. Others think it is an interaction of the liver and the adrenals. One of the most interesting pieces of work in this field was done by C. A. Mills and is concerned with the effect of diet on clotting and basal metabolism. He showed that a carbohydrate and fat diet will raise the basal metabolism but will not increase clotting, while a protein diet not only raises basal metabolism but definitely increases the blood clotting elements, and attributed this to some unknown factor connected possibly with the amino-acids derived from protein metabolism.

In the last few years the German literature has contained numerous articles relative to the chemical changes that cause thrombosis. Zipf stated that freshly defibrinated blood will cause deadly shock when injected intravenously, small quantities (1 to 3 cubic centimeters) cause only a rapid fall in blood pressure. Freund obtained some chemical substances which he called early toxins that he believes are caused by cell deterioration during clotting. These toxins are part of organ

extracts and are found in liver, kidney, lung, spleen, pancreas, and heart muscles. By injecting these toxins, Freund claims, damage was done to the walls of the vessels and to the blood composition, especially the platelets. Koenig states that a thrombus always occurs when the platelets do not increase after operation. Koenig believes the poisonous substances from destroyed muscles can be compensated by injection with the person's own blood.

Starlinger and V. Seemen found that a change in the proportion of protein brings about thrombosis, globulin, and fibrinogen increase, while albumin decreases, thereby bringing about a lowering of the electronegative charge.

We felt in the beginning of our work that if we could study routinely the pre-operative and postoperative blood clotting factors of patients undergoing surgical procedures we might find a predisposing cause toward thrombosis and phlebitis. Over 3 years ago Mr. Charles Frueauff, a native of Denver, was good enough to donate a fund for a period of 5 years for the study of some surgical problem. With this fund we were able to employ a full time technician, and with the aid of Dr. Kugelmass, of the Department of Pediatrics of the Fifth Avenue Hospital, we initiated the study of prothrombin, fibrinogen, antithrombin, blood platelets, and platelet lysis as our routine examination of patients admitted into the surgical wards. These examinations have been made before operation and on the fifth and ninth days after operation. As our experience increased we found that the platelet count and the platelet lysis were unnecessary in our determination. By placing the factors tending toward clotting, that is, prothrombin and fibrinogen, as the numerator, and antithrombin (which deters clotting) as the denominator, we have been able to work out a clotting index. As the normal prothrombin index is 1 and fibrinogen 0.5 to 0.7 per cent, and the normal antithrombin index 1, our normal clotting index then becomes 0.5-0.7. We have considered that an index over 1 indicates a tendency toward pathological clotting and values below 0.3, a marked tendency to bleed (Table I).

tention and slowing down of peristalsis the bacterial flora of the intestinal canal must multiply to a marked degree. Moreover it would seem probable that with the thinning out due to distention of the intestinal wall more bacteria may enter the blood stream.

e Dehydration with resultant increased viscosity of the blood is another factor mentioned as an etiological cause of thrombosis. It is hard to estimate in the first 48 hours after operation the increase of fluid output over the fluid intake. With postoperative purgation increased sweating due to postoperative elevation of temperature vomiting and urination the fluid output is tremendously increased. At the same time the oral intake of fluids is markedly diminished.

TREATMENT

If we base our treatment upon our theoretical concepts of the etiology of thrombosis and thrombophlebitis the following suggestions are offered for consideration.

1 In abdominal cases every effort should be made to reduce the postoperative nausea and vomiting in order to keep the abdominal wall and field of operation quiet. In peritonitis and in the high upper abdominal cases the Levin tube inserted through the nostril immediately after the patient has regained his consciousness greatly reduces vomiting.

2 The approach for an abdominal operation is usually through a layer of subcutaneous fat care should be taken therefore to avoid traumatizing the fat by overzealous pull of the retractors. The irrigation of the fat with ether before closure would seem advisable in order to dissolve out the free particles.

3 The prevention of slowing of the blood stream. Pool in 1913 published an article on

Systematic Exercises in Postoperative Treatment¹ in which he illustrated the type of exercises to be used and recommended that treatment be started on the third day after operation. The motion of the arms and legs would in no way interfere with the healing of the wound and would tend to improve the circulation.

4 The prevention of infection. In our opinion tight abdominal dressings should be

eliminated. G W and Kingsley Roberts of the Fifth Avenue Hospital staff for years have not used any abdominal dressings and have concealed their wounds with court plaster strips. They have been able to show that their incidence of eversion or infection has not been greater than when tight dressings are used. It is our custom to apply sufficient gauze to cover the incision and to hold it in place with merely enough adhesive plaster to prevent its moving. No attempt is made to apply pressure and no abdominal binders are used. During the 3 years this procedure has been followed there have been only two cases of wound eversion which were due I believe to other causes. The patients are infinitely more comfortable and their upper abdominal distention is certainly less when pressure is not applied. On the first day after operation all dressings are inspected and any that feel tight are loosened. Even with dressings applied loosely at the time of operation one is often surprised to see an expansion of at least an inch after the adhesive is cut on the day after operation.

We believe that distention is lessened if food is given early. Theoretically it is logical to a sure that if no food is present in the intestinal tract there is no stimulus for peristalsis and fermentation will take place. If a bolus of food enters the intestine peristalsis is stimulated which will carry with it gas as well as solid material. In non complicated cases after spinal ethylene or gas anesthesia the patient is routinely given tea and toast the afternoon following the morning operation.

5 Dehydration. Fortunately in most clinics the giving of active catharsis the night before operation has been omitted from the pre-operative preparation. Some authors have suggested that the intravenous administration of glucose might be one cause of the increased incidence of thrombosis. Experimentally we have been unable to find any increased clotting factors after glucose administration.

BIOCHEMICAL FACTORS

Physicochemical studies reveal that blood plasma so long as its constituents are not

TABLE II—BLOOD TESTS

Made after (1) Normal Diet, (2) after Forty-eight Hours on a Carbohydrate and Vegetable Diet, (3) after Forty-eight Hours on a Visceral Diet

Dog		Pro-thrombin	Fibrinogen Per cent	Anti-thrombin	Platelets	Index	
No 9949	Normal diet	1 11	0 64	1 16	200,000	0 6	
	Carbohydrate and vegetable diet	1 11	0 64	1 16	200,000	0 6	
	Protein diet	1.45	1 12	0 95	250,000	1 7	
No 9923	Normal diet	1 00	0 54	1 00	400,000	0 5	
	Carbohydrate and vegetable diet	0 74	0 54	1 16	220,000	0 3	
	Protein diet	1 00	0 64	0 95	300,000	0 7	
No 9924	Normal diet	1 11	0 64	1 16	220,000	0 6	
	Carbohydrate and vegetable diet	1 11	0 28	1 00	135,000	0 3	
	Protein diet	1 26	0 69	1 00	210,000	0 9	
No 9888	Normal diet	1 00	0 40	1 16	200,000	0 3	
	Carbohydrate and vegetable diet	1 00	0 40	1 16	325,000	0 3	
	Protein diet	1 11	0 64	0 95	330,000	0 7	

TABLE III—RESULTS WITH BLEEDING DIET

Name	Diagnosis	Date	Clotting time	Bleeding time	Pro-thrombin	Fibrinogen Per cent	Anti-thrombin	Platelets	Platelet disintegration Percent	Clotting	
W	Partial nephrectomy for double pelvis of kidney	5-11	4'15"	1'30"	1 38	1 12	1 00	380,000	65	1 5	
		5-14	4'30"	2'0"	1 00	0 56	1 04	370,000	60	0 5	
		5-21	3'15"	1'30"	1 54	0 69	1 07	420,000	66	1 1	
F	Cystic ovary, chronic appendix	7-26	3'30"	2'0"	0 93	0 56	1 25	500,000	49	0 4	
		8-2	3'15"	2'0"	1 38	0 75	1 00	360,000	59	1 0	
		8-4	4'0"	2'0"	1 38	1 03	0 75	350,000	65	1 8	
		8-7	4'0"	2'0"	0 93	0 46	1 07	265,000	47	0 4	

temperature varying from 99.5 to 101 degrees for 8 to 10 days after operation. (3) Patients who have developed thrombosis or thrombophlebitis. In this group we have studied 27 cases, not only in our own hospital but from the wards of other hospitals, and out of these there have been 4 in whom the clotting factors have been high before the development of the phlebitis. Early in our experimental study, when we were examining the blood on the third and fifth day after operation, one patient had a normal clotting index on the fifth day and developed a phlebitis on the eleventh day. We feel confident that if the blood of this patient had been examined on the ninth day, as in our later routines, she would have shown high clotting factors. The other patients were not studied until the symptoms had occurred, and in all of these the indices were high. Besides this group of 27 we have studied 7 patients with emboli all with high indices, of which 3 showed a

high index before the occurrence of the accident and the rest of which were not seen until after the symptoms had developed.

Animal experiments performed on dogs, wherein vessels were ligated—causing thrombosis and necrosis of the organs they supply, such as gall bladders and appendices—reveal an increase in the clotting factors after the operative procedure.

After having proved to our own satisfaction, both clinically and experimentally, that the clotting factors are raised in thrombosis and phlebitis, we attempted to determine whether the elements could be changed by some therapeutic means, and also to find if the altered blood chemistry had any effect upon the clinical course of the patient. It must be understood that the evaluation of the clinical effects of therapy is most difficult in this type of cases for instance, one cannot foretell whether a patient with high clotting factors and running an irregular temperature

TABLE I.—Th Normal Ind. f Cl tting Fun ti n f
Blood Is Th e 5 = Val es Ind t
M led T nd cy t Cl t d v l bel w 3 Ind cat
T d ncy t Bl d

P thr mb + + A th mb
F brin g n +
Exp g th acti n t m f th l w f mas
t n w ha
[Proth mb] [F b g] [Pl tel ts] =
[A th mb in]
I t d g n mal i f th se b ta es
P th mb d =
F br g = 5 p e t
Pl t l t = 00000
Plat t ly = 5 p t h
Anti th mb in d =

TECHNIQUE OF BLOOD TESTS

Nine cub centimeters of blood are taken from the vein and put into a cubic centimeter of per cent sodium oxalate. Blood centrifuged and the plasma is moved.

P. Prothrombin Index. On a test tube cubic centimeter of the plasma placed in the test tube (6.8 by 3 centimeter square bottom) in a water bath 38 degrees C. and to this are added in series: 1. 3 cubic centimeters of 5 per cent calcium chloride. 2. 6 parts water. The test is continued in the series the prothrombin time. The prothrombin index is the ratio of the clotting of the control to that of the patient's blood.

3. Fibrinogen. (H. Wu, J. B. C. H.) To 1 cubic centimeter of plasma add 8 cubic centimeters of 8 per cent sodium chloride and incubate 1 meter of 55 per cent calcium chloride. Mix and allow to stand 15 minutes. Break up the clot by shaking lightly and centrifuge in a dry filter. Wash filter and insert into a 150 cc glass with point end and lightly. All the fibrin will stick to the end. Slip the fibrin off and add pre-treatment dry filter paper to remove completely a possible addition. Liquid transfer it to a 5 cubic centimeter test tube. Add 4 cubic centimeters of 5 per cent sodium hydroxide. Place the tube in a boiling water bath and with a slender glass rod stir the fibrin lump. Complete lysis of the clot. The fibrin will be solid leaving the calcium salt in suspension. Add 5 cubic centimeters of water. Mix and centrifuge. Transfer the supernatant liquid to a 5 cubic centimeter flask. Centrifuge and pipette 5 cubic centimeters of the supernatant liquid into a 5 cubic centimeter flask. Add 4 cubic centimeters of 2 per cent sodium carbonate solution. Shake and allow to volume. The white solid is precipitated.

M. Assay of fibrinogen. f t t a n d d y s e s l u t i o n t 25 cub centimeter of 1 m e s i l l. Add 0.5 cubic centimeter of phosphoric acid diluted to about 0.5 cubic centimeter and add 4 cubic

centimeters of 2 per cent sodium carbonate. Mix to the volume with water. The standard should be prepared at the same time as the unknown. Let stand for 15 minutes before measuring color comparison.

4. Fibrinogen. (Alfred Hess, J. Exp. Med. 22) Some fibrin plasma is recalcified by adding 3 to 5 drops of 5 per cent calcium chloride. 6 parts of the supernatant in general coagulability of plasma. Heat a cubic centimeter of plasma to 60 degrees C. Prothrombin is destroyed and fibrin coagulated. Filter the coagulum. Plasma contains antithrombin and a prothrombin. Preparation of plasma from normal case the same as recalcified plasma to be tested. Five drops of the plasma are put into 5 tubes. First is a control. Second tube add 3 drops of normal fibrinogen plasma to the tube. Third tube add 5 drops of normal fibrinogen plasma to the tube. Fourth tube add 5 drops of filtered plasma to be tested. Fifth tube add 5 drops of fibrinogen plasma to be tested. All tubes are equalized in amount. Addition of 0.9 per cent sodium chloride. Mixtures are allowed to remain in contact 5 minutes at 37 degrees C. Plasma is recalcified by adding 0.5 per cent calcium chloride. 6 parts of the supernatant are added. Having been determined by the general coagulability test. The clotting time is read at 37.5 degrees C.

The time for the complete examination takes a half hour but the blood of three different patients can be done in 45 minutes. Routine examinations were made of patients before and after operation because it was obvious that one could not predict before operation which patient might develop thrombosis or thrombophlebitis. In addition the blood of a number of patients has been examined who had developed thrombosis thrombophlebitis or embolism.

In analyzing the routine cases examined they may be classified roughly in three groups: (1) Patients with normal postoperative clotting indices and having a normal postoperative convalescence. This group comprised 65 per cent of the total routine cases. (2) Patients with high postoperative indices without obvious peripheral blood vessel lesions approximately 34 per cent. In reviewing the patients with high postoperative blood factors almost universally the convalescence has been abnormal in that there has been a longer continuance of temperature than one would expect and the patients have not clinically progressed as one might wish for instance a hernia would have an elevation of

improving when she developed evidence of phlebitis in the right thigh. We were called in to see her for the first time on the first day of the latter complication. Her blood clotting factors were high and she was immediately given sodium-thio-sulphate intravenously. Her temperature dropped to normal within 24 hours and her pain and swelling rapidly subsided.

The department of fractures at the Presbyterian Hospital of the Medical Center of Columbia University has utilized our technician in the study of the blood clotting factors in patients suffering from fractures with symptoms suggestive of thrombosis or embolism. Following is the statement of Dr. Clay Ray Murray, associate professor of surgery:

"At the Presbyterian Hospital, the clotting index has suggested an interesting line of investigation as to the cause of death in patients with neck of the femur fractures. These patients die from pulmonary complications which are usually considered hypostatic pneumonias and from cerebral complications which are commonly considered fat embolism, 'delayed shock,' or 'senility aggravated by shock.' The patients with hip fractures who develop these conditions have shown clotting indices of 16 to 19 and 3 of the cases have completely cleared up where the clotting index was brought down to normal by the use of sodium-thio-sulphate intravenously. In one patient, when the symptoms recurred and the clotting index was again found up to its original level, a second course of sodium-thio-sulphate (bringing the index to normal) resulted in a second clearing up of the symptoms. On the basis of the findings, considerable support had been given to the assumption that the so called pneumonias are really pulmonary thromboses and that the so called fat emboli are really cerebral thromboses or emboli, both of them dependent upon the double factor of raised clotting index and slowed vascular activity due to bed rest. If this be true it may be possible to control the clotting index and so materially influence the mortality in neck of the femur fractures. Definite investigation of the problem is now planned."

3. In patients in whom infection appears to be the predominating factor and in whom phlebitis and periphlebitis are pronounced and there is a chill and rapid rise of temperature, little if any benefit has been derived from the intravenous administration of sodium-thio-sulphate. We have assumed, in this group, that infection is the predominant, and thrombosis the minor, element. Blood studies show some increase in prothrombin and marked increase in fibrinogen. Following the advice of

Shallenberger we have used intravenous injections of 0.5 per cent gentian violet solution. Ten patients have been treated by this method. We have seen no ill effects save an occasional chill, and have had a number of patients in whom the immediate drop of temperature, relief from pain, and decrease in swelling (from 1 to 2 inches in the circumference of the thigh) in 2 or 3 days' time, would seem to show beneficial effects.

Three cases of migratory phlebitis have been studied. Under a limited diet they have higher clotting factors than normal, but in this small series we have not seen any benefit from any therapy we have advised.

SUMMARY

Four thousand two hundred and fifty patients have been operated upon since the inauguration of this study. Phlebitis has developed in 11 cases. There has been no death from embolism in cases treated under this routine. During this period there have been 3 deaths from embolism in private patients of members of the staff who have not carried out these principles of treatment.

It is hoped that by further study a more simplified blood test may be found which can be used in a general hospital in the routine examination of patients. As we have been handicapped financially we have not been able to employ a full time biochemist to study some of the more intricate problems of which we are ignorant. We have hopes that we may some time be able to employ one, because the elements which alter clotting factors are not yet definitely known. Freund and others have stated various theoretical substances, but the exact chemistry of these has not yet been proved.

Calcium and phosphorus determinations were made on a small series (33 patients), but the variations from normal were so slight that these examinations were discontinued.

CONCLUSIONS

1. We believe that loose abdominal dressings, early postoperative feeding, and fluid administration relieve postoperative distention and distress and may diminish thrombosis.

TABLE IV—INTRAVENOUS THIO SULPHATE

The Effect of Intravenous Sodium Thio-Sulphate on the
Blood Clotting Factors
(D. G. No. 334)

Initial clotting index	Experimental procedure— in intravenous	Final clotting index
9	5 ml N S_2O	5
67	5 cm N S_2O	45
9	5 cm N S_2O	7
8	5 cm 5 per cent	
	glucose	8
8	5 cm 5 per cent	
	glucose	8
9	5 cm N S_2O	6
8	5 cm N S_2O	6
8	5 cm N S_2O	55

will or will not develop thrombosis if untreated. In addition the course of phlebitis varies so greatly in the individuals that it is difficult to ascertain clinically whether any therapeutic measure is of value. Even if one asks a patient if he feels that an intravenous injection has been of any benefit the mere psychic effect of such treatment and the doctor's own enthusiasm may stimulate an affirmative answer. We have tried to be fair in evaluating our results.

At Dr Kugelmass' suggestion we studied the effect of diets on human beings and dogs. A diet low in fat and protein will decrease the clotting factors whereas a diet rich in nucleoproteins will cause a marked increase (Tables II and III). There are difficulties however in using diet solely as a postoperative means of treatment. Many patients are so weak after operation that they cannot be put on a restricted diet. Moreover a quicker means is advisable in some cases. We have hoped to find some drug which can be injected intravenously that would show beneficial clinical and chemical results. At the suggestion of Dr Charles Lieb of Columbia University we have used sodium thio sulphate. It has been used empirically as we do not know its exact chemical action. Dr Lieb had used this drug to prevent extracorporeal clotting in animal experiments and assured us that it was non-toxic. When injected into animals it causes a very definite decrease in the prothrombin but has very little effect on the fibrinogen. Clinically we have used 10 cubic centimeters of a 10 per cent solution intravenously for 3 successive days repeating the series after a

period of 2 to 3 days interval if results are unsatisfactory (Table IV).

RESULTS

As we have stated our results are based on chemical blood examinations before and after treatment and a study of the temperature charts patients' statements and a general analysis of cases. We must again sub-divide the patients operated upon into three groups.

1. Patients running irregular postoperative temperatures without signs of peripheral vein lesions but with high clotting factors. In the routine study of cases in which there have been high clotting factors after operation and in which sodium thio sulphate has been administered there was a temperature drop, alteration of the blood content and clinical improvement as voiced by the patient in approximately 50 per cent. In the remainder very little change could be noted save that none of them developed a phlebitis or thrombosis. In order to determine whether or not the routine postoperative administration of sodium thio sulphate was of any advantage we have recently taken alternate cases submitted to surgical operation. These patients have been treated exactly alike save that one series was administered sodium thio-sulphate and the controls were not. Irrespective of the operative procedure postoperative course or the blood examinations. The series is too small for didactic conclusions: 22 cases having had sodium thio sulphate administered and an equal number having been used as controls. It is interesting to note however that in 2 of the control cases phlebitis developed and in one a pleurisy while in none of the patients who had sodium thio sulphate did complications develop.

2. Patients with low grade phlebitis without marked elevation of temperature but with definite tender swelling of the limb. It has been our impression in the study of these cases that if treatment is prescribed early in the disease definite improvement is noted but if the disease is fairly advanced there has been little value derived. Let me cite one example.

A patient in the Presbyterian Hospital had a left phlebitis followed by a pulmonary embolism. He had had blood drawn 3 days before

ogy of the placenta. Perhaps the one outstanding fact gathered from an extensive survey of the literature is that no group of investigators has confined its efforts to the study of the normal and pathological physiology of the placentation of one animal. Experiments dealing with the permeability of diverse substances have been made on almost all laboratory animals and the results naturally are conflicting, for there is a difference in the placentation of animals.

In order to arrive at more definite conclusions regarding the physiology of the placenta, an exhaustive study of the placentation of one animal seemed advisable. With this in mind, we have been studying for the past 5 years the physiology of the placentation of the albino rat. Our particular interest has been concerned with the study of the transmission of immunity from mother to offspring while *in utero*. However, we discovered that in many instances we were unable to interpret our negative results because of lack of knowledge of the fundamental physiology of the placenta.

One of the fundamental physiological problems confronting us in the analysis of our results was the normal rate of transmission of substances to which the placenta is permeable in either direction between fetus and mother. A review of the literature reveals no definite statement concerning this phase of the problem and, therefore, the following experiments were carried out in an attempt to establish some definite rate for the transmission of soluble substances through the placenta of the white rat.

For the study of the rate of permeability, we selected colored solutions, since they would give us a definite and easily read index. We have tried, as have many other investigators, the colloidal dyes that are used for staining, and arrived at the same conclusions as the others, namely, that inert colloidal dyes are not normally transmitted through the placenta. As early as 1867, Jassinsky injected a suspension of carmine into pregnant dogs and, although the animals died from this procedure in about 20 minutes, he observed that the substance did not reach the fetal circulation, but was held in the placenta. Schlect (1907) describes a pregnant mouse which had

been stained by the injection of lithium carmine. The dye had failed to stain the fetuses but was plainly visible in the placenta and fetal membranes. Goldman (1909) injected a number of pregnant mice and rats with colloidal solutions of pyrrhol-blue and trypan blue, and in every instance the tissue of the mother became deeply stained, but the fetuses remained unstained. Wislocki (1922) working with trypan blue solutions concluded that foreign colloidal material can not pass from the fetal into the maternal circulation. Yoshitaka Schmidzu (1922) published a comprehensive study on the permeability of the placenta by dyestuffs in the albino rat and the white mouse. In his experiments he employed twenty-three dyes. A solution of each dye was injected hypodermically between the scapulae and, at varying intervals from 4 to 48 hours after injection, the fetuses were removed by caesarean section, and the coloration of the maternal and fetal tissues determined by various detection methods. He concluded from his studies that the placenta of the white rat and mouse are permeable to all the basic dyes and that the power of the dyes to pass through the placenta runs parallel with the colloidal state of their solution in the serum, especially with their ability to spread in a gel of high percentage.

MATERIALS AND METHODS

We considered the dyes used by other investigators not suitable for use in the study of this particular problem, because colloidal dyes, as found by them, do not pass through the placenta and those colloidal dyes of high dispersion that Schmidzu concluded pass the placenta permeate very slowly. Moreover, the more soluble dyes used in their experiments possessed powerful staining qualities which caused the dyes to unite with the tissues. We were interested in finding a soluble dye or group of dyes which would be easily detectable, which would not combine with the tissues, and which could be recovered unchanged chemically from the fetus after injection of the dye into the mother or from the mother after its injection into the fetus. A dye suitable for the needs of our present investigation must have the following characteristics:

2 Blood studies show that certain individuals are more prone to develop thrombosis than others. The blood abnormalities can frequently be improved by diet and intravenous medication.

3 There are probably substances liberated in the blood through the effects of operative and postoperative trauma and infection that tend to change normal into abnormal clotting factors. The elimination of operative and postoperative trauma would diminish this incidence. Routine blood studies frequently show alterations in the clotting factors before the onset of thrombosis and thrombophlebitis. It is our belief that in a number of cases thrombosis and embolism may be aborted by administering a diet low in fats and proteins and the intravenous administration of sodium thio sulphate.

4. We are not satisfied that sodium thio sulphate is the best method of approaching this problem but at present it seems to be a definite aid.

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THE TIME OF PERMEATION OF COLORED SOLUTIONS THROUGH THE PLACENTA OF THE WHITE RAT

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THE physiology of the mechanism governing the interchange of substances through the placenta from mother to fetus and from fetus to mother has attracted the attention of numerous investigators since the beginning of scientific medicine and biology. The chief interests lie mainly in three fields of study: first, that concerned with the nutrition and elimination of waste products of the fetus; second, a group dealing with the

possible transmission of acquired biological qualities from mother to fetus and third that field concerned with the harmful or beneficial interchange of hormones internal secretions and toxic products from mother to fetus and vice versa Although an extensive literature pertaining to the interchange through the placenta of substances both nutrient and biological has been produced little is still known of the normal or pathological physiolo-

mal In the phenolsulphonephthalein and cochineal experiments, equal parts of the urine were placed in two Wassermann tubes and a few drops of 1 per cent sodium hydroxide were added to one tube and the color compared with the color of the other tube Samples of urine which were used in the saffron experiments were taken but gave no conclusive results because of the yellow color of both saffron and urine

Only phenolsulphonephthalein was used in testing the passage of coloring solution from mother to fetus In this series of experiments the mothers were anesthetized with amytal and injected intravenously (femoral vein) with 2 cubic centimeters of 0.6 per cent phenolsulphonephthalein solution At definite times, ranging from 15 minutes to 2 hours after the initial injection, all the fetuses were removed from the various injected animals, thus, at the end of 15 minutes all the fetuses were removed from the first animal, at 35 minutes from the second animal, and so on until 2 hours had elapsed The fetuses were stripped of their amniotic sacs and washed in normal saline, then cut into pieces, placed in a large centrifuge tube, and centrifuged for 30 minutes The supernatant serum was pipetted off, divided into equal parts, and placed in two Wassermann tubes To one part was added a few drops of 1 per cent sodium hydroxide and the color was then compared with that of the other part The amniotic fluid and the normal saline in which the fetuses had been washed were also tested for the presence of the dye by the addition of 1 per cent sodium hydroxide

The placenta from these fetuses were separated from their maternal attachments They were not washed and the maternal blood that collects on the placenta in its detachment from the wall of the uterine horn was not removed The placenta were cut into small pieces and centrifuged with a small amount of isotonic sodium citrate solution The supernatant fluid was pipetted off and tested in the same way for phenolsulphonephthalein Sodium hydroxide was also dropped on pieces of placenta, placental site in the uterine horn wall, and on the cut fetus, and color changes looked for in the various tissues

EXPERIMENTS

The experiments consisted of three groups (I) the determination of the rate of passage through the placenta of colored solutions from fetus to mother, (II) experiments to ascertain the rate of passage through the placenta of colored solutions from the amniotic sac of the fetus to the mother, and (III) the analysis of the permeability of the placenta to soluble dyes injected into the mother

Control experiments were first made with phenolsulphonephthalein, cochineal, and saffron to determine the minimal amount of dye necessary to give a definite color reaction to the mother's serum, detectable by our gross methods In these experiments, 1 minim of the dye injected into the femoral vein of the rat gave a definite color change to the serum taken from the animal after 5 minutes, serum obtained from the animal before injection being used as a control As the control experiments demonstrated that 1 minim of each of the coloring solutions selected was sufficient to give a definite color to all the serum in the animal, it was evident that the total of 6 to 12 minims that were being injected into the fetuses was sufficient to give a definite color test in the serum of the mother, if but a small proportion passed through the placenta

The results of the passage of the dyes from fetus to mother are tabulated in Table I In the case of each of the three dyes, a definite color change was noted in the serum of the mother Ten experiments (Table I, Experiments 1 to 10) with phenolsulphonephthalein were made The dye was detected in the mother's serum 5 minutes after injection into the fetuses (except in one instance), increasing in intensity up to 3 to 4 hours after injection and then gradually fading away The urine of these animals showed a positive reaction from 10 to 20 minutes after injection Five experiments were made using cochineal injections (Table I, Experiments 11 through 15) The dye was first demonstrable in the serum of the mother 10 to 15 minutes after injection of the dye into the fetuses In 4 experiments (Table I, Experiments 16 through 19), saffron was injected into the fetuses and mother's serum usually took on the saffron color within 10 to 20 minutes after injection

- 1 The dye must have a high degree of solubility
- 2 A very small amount of the substance must color a large quantity of fluid or serum
- 3 The coloring substance must not react chemically to any great degree with the tissue and thus be taken up by the tissues
- 4 It must remain stable undergoing no chemical change when it is injected into the tissues

5 It must be non toxic to the organism

We experimented with many of the histological dyes indicators and coloring materials now on the market finally choosing three as most suitable for use in our experiments. The first and most satisfactory is phenol ulphone phthalein (phenol red) an indicator which is a red solution at a hydrogen ion concentration of 7.6. The second cochineal also an indicator obtained from the dried fecundated insect *coccus cacti* Linné is a yellow solution below a hydrogen ion concentration of 4, changing to a red brown between 4 and 5 and to lilac at a hydrogen ion concentration of 5. Cochineal only acts as a powerful dye when a mordant such as salts of zinc bismuth or nickel is added. The third saffron is extracted from the dried stigmas of the *crocus sativus*. Its solution has an orange or deep yellow color which is not changed by the hydrogen ion concentration range of body fluids.

Phenolsulphonphthalein as supplied in ampuls for kidney functional tests was used in our experiments. Each cubic centimeter of the solution contains 6 milligrams of the dye. In preparing a saturated solution of cochineal a quantity of the cochineal bugs was ground in a mortar with pestle distilled water added the mixture stirred for about 10 minutes then allowed to stand for several hours after which time the supernatant fluid was decanted and filtered through filter paper. A saturated solution of saffron was prepared in the same way from the dried stigmas of the *crocus plant*.

Pregnant white rats *mus norvegicus albus* selected from the colony of the Department of Anatomy of the University of Pittsburgh were employed. Whenever possible rats from the sixteenth to twenty first day of gestation were used.

The method employed in determining the permeability of the placenta and the time of transmission of the colored solutions from fetus to mother conformed with the following general routine. The pregnant animal were anesthetized by injecting intraperitoneally a 2 per cent solution of sodium amytal a dosage of 80 milligrams per kilogram of body weight being used. After the rat was in deep anaesthesia 1 cubic centimeter of the mother's heart blood was drawn centrifuged the serum pipetted off and placed in a Wassermann tube to be used as the control serum. The abdomen of the rat was then opened and the gravid uterine horns were exposed. From 1 to 2 minims of the colored solution were injected in one group of experiments into the abdominal cavity of each fetus and in another group into the amniotic sac of each fetus. Usually a total of from 6 to 12 minims of the coloring solution could be injected into the fetuses or amniotic sacs. The injection was made directly through the uterine wall by means of a Luer syringe with a spring attachment and a No 27 gauge needle. Extreme care was taken not to allow any of the coloring fluid to enter any part of the mother especially the space between the amniotic sac and the wall of the uterine horn. The time of injection was noted the injection of the first fetus being taken as the time of injection. An inspection was made of the uterine horns for leakage into the uterine cavity and then the uterine horns were carefully replaced in the abdominal cavity and the abdominal wall was closed. One to 2 cubic centimeter samples of mother's heart blood were drawn at various intervals ranging from 1 minute to 4 hours. As a rule four or five heart punctures can be made without killing the animal. The blood samples were centrifuged the serum pipetted off into a Wassermann tube and in the phenolsulphonphthalein and cochineal groups of experiments a few drops of 1 per cent sodium hydroxide was added to all sera including the controls. On a white background and in the daylight when possible the color of the control serum taken before the injection of the coloring fluid into the fetus was compared with the color of the sera taken after injection. Urine from the bladder was obtained after death of the ani-

TABLE II—PHENOLSULPHONEPHTHALEIN INTO AMNIOTIC SACS

Injection of Phenolsulphonephthalein into the Amniotic Sacs of Fetuses and Testing for the Dye in the Serum of the Mother

No	Dye injected	Amount, minims	No of amniotic sacs injected	Age of fetuses (days)	Mother's serum	Urine
24	Phenolsulphonephthalein	6	6	20	10 min.—negative 60 min.—slightly positive 90 min.—slightly positive	90 min.—positive
25	Phenolsulphonephthalein	6	7	10	15 min.—negative 30 min.—negative 60 min.—negative 105 min.—negative	105 min.—very positive
26	Phenolsulphonephthalein	12	8	20	30 min.—very slightly positive 60 min.—very slightly positive 95 min.—slightly positive 120 min.—positive	Not taken
27	Phenolsulphonephthalein	12	8	10	30 min.—very slightly positive 60 min.—positive 90 min.—slightly positive	Not taken
28	Phenolsulphonephthalein	12	12	15	30 min.—very positive 90 min.—very positive	Not taken

TABLE III—INJECTION OF PHENOLSULPHONEPHTHALEIN INTO MOTHER'S FEMORAL VEIN

Injection of 2 Cubic Centimeters of 0.6 Per Cent Phenolsulphonephthalein into Femoral Vein of Mother and Testing for the Dye in Placenta, Fetal Tissues, and Amniotic Fluid

No	Dye injected	Amount c cm	Time of test after injection of dye	No of fetuses macerated	Approximate age of fetuses	Serum from macerated fetuses	Addition of NaOH to fetal tissues	Amniotic fluid	Serum from macerated placenta	Addition of NaOH to placental tissue	NaOH on placental site and uterine tissue	Mother's heart blood
29	Phenolsulphonephthalein	2	¼ hr	4	18	Negative for dye	No color change	Negative for dye	Very positive for dye	Pink red color change	Pink red color change	Positive for dye
30	Phenolsulphonephthalein	2	¼ hr	4	19	Negative for dye	No color change	Negative for dye	Very positive for dye	Pink red color change	Pink red color change	Positive for dye
31	Phenolsulphonephthalein	2	¾ hr	4	20	Negative for dye	No color change	Negative for dye	Very positive for dye	Pink red color change	Pink red color change	Positive for dye
32	Phenolsulphonephthalein	2	1 hr	4	18	Negative for dye	No color change	Negative for dye	Very positive for dye	Pink red color change	Pink red color change	Positive for dye
33	Phenolsulphonephthalein	2	2 hrs	4	19	Negative for dye	No color change	Negative for dye	Very positive for dye	Pink red color change	Pink red color change	Positive for dye

sue were positive 5 minutes after the injection of phenolsulphonephthalein into the mother, and evidence of the dye could be found in the placenta and uterine tissue as long as the serum of the mother remained positive. Thus, although the dye was found in the placenta and circulating through the uterine tissues about the placental sites, no evidence of it was found in the fetal tissues or amniotic fluid

DISCUSSION

It was hoped, originally, to study the rate of transmission of colored solutions through the placenta not only from the fetal tissues

and the amniotic sac to the mother but also from the mother to the fetus. The results of the experiments failed to show transmission of phenolsulphonephthalein from mother to fetus, therefore, this phase of the problem is still unsolved. On the other hand, the dyes readily passed from the fetal tissues to the maternal circulation.

After the injection of phenolsulphonephthalein into the fetus large quantities of the dye were found in the maternal circulation in 5 minutes, cochineal was recovered in large quantities within an average of 10 minutes, and, saffron within an average of 15 minutes

TABLE I—INJECTION OF DYE INTO ABDOMINAL CAVITIES

Inj tu f Dy S l t u n s to Abd min l C ties f
Fetu es d Testu gf Dy in S rum of the M th

N	Dye injected	Amn min	N sec	Age days	M hera se m	U
	Ph 1 l h bthal in		6		m 80 min	N d
	Ph 1 ul h nephthalein		9		m 60 min	N tested
3	Ph 1 l h e-phthalein	6	6	8	m 5 min max	N tested
	Ph 1 ul h phthal in	8	8		5 min max 60 min max 60 min max	hrs post
8	Ph 1 l h bthal in	8	6		m 60 min	N tes d
6	Ph 1 l h phthal		9		m 5 min m 5 min m 5 min	5 min post
	Phen 1 l h phthal in				m 5 min m 5 min m 5 min m 5 min m 5 min m 5 min m 5 min	N tested
8	Ph 1 l h e-phthal in		8		m 5 min m 5 min m 5 min m 5 min m 5 min m 5 min	m post
	Ph 1 l h phthal in		8	8	m +	N tested
	Ph 1 ul h bthal		6		m +	N ted
	Cochineal		6	6	m +	N tested
	Cochin al		8	8	m +	N tes ed
	Cochineal				5 min +	N tes d
4	Cochin al		8		m +	N es d
5	Cochin al		8		m +	N tes ted
6	Saff				m +	N not tested
7	Saff				m +	N tested

TABLE I—C tin ed

N	Dye injected	Amn min	N sec	Age days	Moth seru	U
8	Saffro		0	8	m +	N red
	Saff		8	8	m +	N not ted
	Ph 1 ul h phthal in				5 m min 60 min min	m post in
	Ph 1 ul h phthal in			9	m min 60 min	m post in
	Ph 1 ul h bthal in			8	m min 60 min	m post in
	Ph 1 ul h phthal in				m min 60 min min	m post in

Five experiments were made in which phenolsulphonophthalein was injected into the amniotic sacs of the fetuses. The results of these experiments are tabulated in Table II. The first positive test appears usually from within 30 minutes to 1 hour. Thus it takes from six to twelve times as long for the dye to pass from the amniotic sac through the placenta as it does when the dye is injected into the abdominal cavity of the fetus.

In the third group of experiments phenolsulphonophthalein was injected into the blood stream of pregnant rats and sought for in the fetuses. In no instance in the five experiments (Table III) was the dye recovered from the fetal tissues or the fluid in the amniotic sac. The supernatant sera of the centrifuged macerated fetuses did not change color when a solution of 1 per cent sodium hydroxide was added. Likewise amniotic fluid or normal saline in which fetuses were washed did not show any of the dye. However when sodium hydroxide was added to the supernatant sera of the unwashed macerated placenta the color of the sera changed to a deep red. When pieces of the placenta and the uterine horn tissue about the placental sites were tested by dropping sodium hydroxide on them these tissues turned a deep red or violet. The tests on the supernatant sera obtained from the macerated placenta placental and uterine tis-

The concentration of the dye in the fetal and the maternal bloods, must be somewhere near equal since in the former case, 2 minims of the dye was injected while in the latter 2 cubic centimeters of the dye was injected. Since there is no experimental evidence available concerning the ratio of the volume of fetal blood that passes through the placenta to the volume of maternal blood that bathes the villi, the rôle that the circulatory balance plays in our results is a moot question. The theory of a selective permeability of the placenta has been denied by many investigators. However, it is difficult not to take it into consideration in the light of our experimental findings and the numerous clinical observations of the difference in the concentrations of substances in the maternal and fetal bloods. One of the most frequent examples of this is that in pregnant women with diabetes, although the blood sugar of the mother is very high, the cord blood is within normal limits. Schlect (1907) goes so far as to say that he believes that one of the chief functions of the chorionic cells is to protect the fetus from toxic substances which may be present in the maternal blood stream.

Our work does not give any definite proof of a selective activity governing the interchange of substances through the placenta. However, as our work progresses and as we obtain more evidence regarding the reaction of the placenta to substances injected into the fetus and mother, we are accumulating evidence confirming the opinion that the placenta is not a semi-permeable membrane subject only to the laws of osmosis, diffusion, and permeability, but that it reacts to vital factors concerned with the nutritional and excretory needs of the fetus and the physiological balance between the factors concerned with the maintenance of a normal functional activity of the maternal and fetal organisms.

CONCLUSIONS

1 Phenolsulphonephthalein, cochineal, and saffron when injected into the fetus or amniotic sac are readily absorbed and pass through the placenta into the circulation of the mother.

2 The time of absorption and transmission of phenolsulphonephthalein from the fetus through the placenta in large enough quantities to be detected in the serum of the mother is 5 minutes, for cochineal 10 to 15 minutes, and saffron 10 to 20 minutes.

3 The time of absorption and transmission of phenolsulphonephthalein from the amniotic sac through the placenta in sufficient quantity to be detected in the serum of the mother is within 30 minutes to 1 hour or six to twelve times slower than when phenolsulphonephthalein is injected into the fetal cavities or tissues.

4 Phenolsulphonephthalein was not recovered from fetal tissues after injection of large quantities of the dye into the circulation of the mother although large amounts of the dye were recovered from the placenta.

We wish to express our appreciation to Dr Davenport Hooker and Dr John Donaldson, Department of Anatomy, University of Pittsburgh, and to Dr Robert Tennant, Jr, Department of Pathology, Yale University, for helpful suggestions during the progress of this work.

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Thus all the dyes were rapidly absorbed and eliminated from the fetal tissues through the placenta into the maternal circulation.

When phenolsulphonophthalein was injected into the amniotic sac the dye was found in large quantities in the maternal circulation between thirty minutes and one hour. Thus it took the dye six to twelve times longer to pass from the amniotic sac to the circulation of the mother than from the fetus to the mother. The mode of absorption and transmission of substances from the amniotic sac to the maternal circulation has not been satisfactorily worked out in the rat. However, Wislocki (1920) studied the absorption of trypan blue injected into the amniotic cavity of the guinea pig and cat and concluded that this substance is absorbed during the latter half of pregnancy, the absorption occurring in three ways: (a) through the gastrointestinal tract, (b) through the respiratory tract, and (c) by diffusion through the amniotic membranes. Observations on the absorption of sodium amytal from the amniotic sac of the rat fetus have been previously reported by us (Boucek and Renton, 1931). It was found that this anesthetic injected either into the amniotic sac or the fetus caused anesthesia of the mother. The time of absorption and transmission of this substance from the amniotic sac was much slower than from fetal tissue. This observation is in accord with the present experimental results.

The time of transmission from fetus to mother in these experiments includes three factors: first, the rate of absorption of the dye; second, its transmission through the placenta; and third, the time required for enough dye to accumulate in the blood of the mother to overbalance its excretion by the kidneys and give a sharp test. Since the time of transmission of the dye through the placenta was our chief interest, it seemed advisable to reduce the 2 other factors to a minimum. The first was to a great measure eliminated by using dyes that are quickly absorbed and do not readily stain or react with the tissues. The third factor was reduced in importance by injecting many fetuses or amniotic sacs and thus producing a larger transmission surface and furthermore a larger absorption surface.

This fact was made clear to us during the first experiments carried out in which only a single fetus was injected with 2 millimeters of the dye (Table I, Experiments 20 through 24). In no instance could the dye be demonstrated in the heart's blood although it was recovered in large quantities from the urine. Evidently, the amount that was being poured into the blood stream of the mother was not sufficient at any time to overbalance the elimination by the kidneys. When however a number of fetuses or amnia were injected, positive tests were obtained in the blood. With these two factors reduced to a minimum, the observed time of transmission of the dyes may be taken as a close approximation of the actual time of transmission.

These experiments give no evidence concerning the time of transmission of soluble substances from the mother to the fetus, since phenolsulphonophthalein was not found in the fetus or in the amniotic sac after injection of large quantities of the dye into the mother. The macerated unwashed placenta, however, contained large quantities of the dye as did also the uterine tissues and blood. The presence of large quantities of the dye in the placenta and in the tissues of the uterine wall and the absence of it in the fetus leads us to conclude that phenolsulphonophthalein does not pass in measurable quantities from mother to fetus under these experimental conditions.

There are many factors that might be involved in producing the positive results of the permeation of the placenta by the dye from fetus to mother and the negative results of the failure of the dye to permeate the placenta from mother to fetus. Those to be considered are chiefly: (a) the concentration of the dye in the fetal blood circulating through the placenta after its injection into the fetus as compared with the concentration in the maternal blood reaching the placenta following the injection into the mother; (b) the circulatory balance between the amount of fetal blood passing through the placenta and the amount of maternal blood that comes in contact with the placenta; and (c) the ability of the placenta to allow the dye to pass in one direction and prevent it from passing in the other direction.

all first described by Bernard, in 1853. Later references to his report seem to be based on a gross misinterpretation. Desgranges, a few months later, discusses Bernard's operation as being poorly devised since (according to Desgranges) the triangles were excised from the upper lip itself with the result that the upper lip was thereby shortened and the mouth narrowed. Bernard's report seems perfectly plain, in that he did excise the triangles above and lateral to the angles of the mouth and conserved the mucosal surfaces attached at the bases to be reflected forward and sutured so as to form the vermilion border of a new lower lip. Blair and others erroneously credit Stewart with devising the latter modification in 1910.

GENERAL PRINCIPLES OF INFERIOR CHEILOPLASTY

Many of the classical methods suited only to the smaller lesions of the lower lip have been rendered superfluous by irradiation therapy, especially during recent years when proper dosage and better technique, based upon a better understanding of the physical principles of radiation, have given such eminently satisfactory results, both from the curative and cosmetic standpoints. We are of the opinion that the simple V-shaped operation should never be used as the primary treatment. It is suited only to the very early small lesions, and in any case is followed by more deformity and scarring than is irradiation. In massive neglected growths, where much normal tissue has been destroyed by replacement with tumor tissue, destruction of the disease by irradiation and later repair by plastic surgery is the safest procedure. Those opposed to irradiation will overemphasize the difficulty of plastic surgery in irradiated tissue. In our experience, the obstacle is not a serious one, provided the surgeon himself handles the case from beginning to end, and plans the irradiation and subsequent surgery so that the maximum benefit is derived from each agent. The radiotherapist and the surgeon should be one and the same person and each separate procedure should be planned with a view to the entire problem, which includes the care of possible subsequent metastases to the neck. A procedure such as the one described is suited to excision and repair of large defects and is not intended for the repair of the lesser defects following irradiation.

In our opinion inferior cheiloplasty should always be done by the use of full thickness flaps of cheek or lip. Methods utilizing flaps of skin from the neck are more subject to failure and in

cases involving the lower lip will give much less satisfactory functional and cosmetic results. The same is true of defects of the upper lip and anterior portions of the cheek. Large defects involving the posterior portions of the cheeks may require a combination of methods. In any form of cheiloplasty or meloplasty, the oral surface of the repair should be lined by epithelial tissue. A raw surface within the mouth will subsequently heal by scarring and contracture, ending in a partial cosmetic and functional failure. The ideal oral lining is obviously mucosa, and the use of skin for the inner surface necessitates either two flaps or the doubling of a skin flap, and the chances of failure are thereby increased.

In inferior cheiloplasty the advantages of cheek flaps with their mucosal lining are of extreme importance. The new lower lip must provide for an adequate gingivobuccal gutter, otherwise, drooling of saliva will result. The normal lower lip is very loose and flexible, and is maintained in position by the combined action of the orbicularis, the risorius, and zygomaticus. After wide excision, the new lower lip, if it is to escape sagging and gradual contracture downward, must be more taut in the horizontal plane, since it will be less supported by the horizontal cheek muscles and not at all by the orbicularis. It will be readily understood that these principles are followed if the new lower lip is constructed from the cheeks, but that sagging and contracture are bound to follow a doubled skin flap from the neck.

Although the lower lip is quite elastic, cheiloplasty, after excision of as much as one-half of the vermilion border, is followed by a shortened lower lip and a redundant overhanging upper lip. Excision of triangles above and lateral to the labial commissures permits the correction of this deformity and the lengthening of the lower lip. The conservation of the mucosal surface of these flaps attached inferiorly and their suture to the raw surface of the new lower lip will form a new vermilion border (Fig. 2).

The operative procedure must be somewhat modified if the involvement of the lower lip is markedly to one or the other side, but in the average case it is advisable to attempt the same extent and form of procedure on either side, so that the two sides of the face appear uniform when viewed from the front. Following a plastic of this extent, the appearance of the face is, of course, altered, but this is less noticeable if the two sides of the face are uniform in appearance.

The incisions from the vermilion border of the lower lip on either side of the growth should, in the average case, run vertically to the lower edge

CLINICAL SURGERY

FROM THE MEMORIAL HOSPITAL NEW YORK

CHEILOPLASTY FOR ADVANCED CARCINOMA OF THE LIP¹

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SURGICAL excision as the primary treatment for carcinoma of the lip has been largely replaced by irradiation therapy. The average growth of the lower lip is most satisfactorily treated by irradiation which in competent hands will result in practically 100 per cent cures of the local lesion. Metastasis to the neck is of course an entirely separate problem under any method of treatment. The cosmetic result even after heavy irradiation is excellent. There is little or no scarring and the contour of the lip remains unchanged unless there has been replacement *en masse* of normal by neoplastic tissue.

Although surgery has no longer a place in the treatment of the small or moderately sized lesion, extensive surgical excision of the lower lip with plastic closure must be resorted to in the bulky fungating and infected tumors which sometimes occur in the neglected case. The growth may involve the entire thickness of the lip and extend down into the subcutaneous tissues over the symphysis mentis. Massive local recurrences after incomplete surgical excision or the recurrences in devitalized tissue following repeated inadequate irradiation may likewise call for extensive local removal. The operation to be described is a method of construction of an entire new lower lip and chin. It is a modification of an operation first described by Camille Bernard in 1853. This operation permits a wide removal and furnishes a functionally satisfactory new lower lip and leaves a minimum of visible scarring.

A surgical procedure of the extent described is not justified in the presence of large multiple or bilateral metastases. The operation should be cautiously proposed even in the presence of a single small metastasis for which in any case the surgeon must assume the responsibility for adequate removal. The operative exposure will permit a limited removal of gland-bearing tissue from the submental and submaxillary regions but

no extensive neck dissections can be carried out during this operation. If a limited bilateral neck dissection or a block dissection of one side is indicated the disease is probably too far advanced and malignant to be successfully dealt with by surgery alone. The operation here described is best suited to the bulky fungating types of growth in which metastases are quite commonly absent.

HISTORICAL NOTE

The origins of cheiloplasty for cancer of the lower lip are lost in antiquity. Celsus (born about 25 B.C.) described the V shaped incision as well as modifications to include horizontal incisions from the angles of the mouth and also horizontal incisions along the lower edge of the mandible so as to form two lateral flaps of the cheeks. Operations of this type are often referred to as the methods of Celsus.

Most of the classical methods now described in surgical texts were devised during the first half of the 19th century. Von Bruns in 1839 described 32 methods by 52 authors. The general principles of the method described in the present report were first published by Camille Bernard in 1853. The principles of this operation are usually credited to Burow whose methods for the plastic closure of defects by the excision of adjacent triangles were published by his associate Saemann in 1853. The triangular flap method of Burow however necessitates a V shaped excision of the lower lip and (for reasons to be discussed) the operation has a limited range of application mainly to the smaller lesions of the lip.

The excision of a rectangular or square segment of the lower lip, the formation of two lateral cheek flaps mobilized from the mandible, the excision of full thickness triangles above and lateral to the angles of the mouth and the conservation of the mucosa of these triangles to form the vermilion border of the new lower lip were

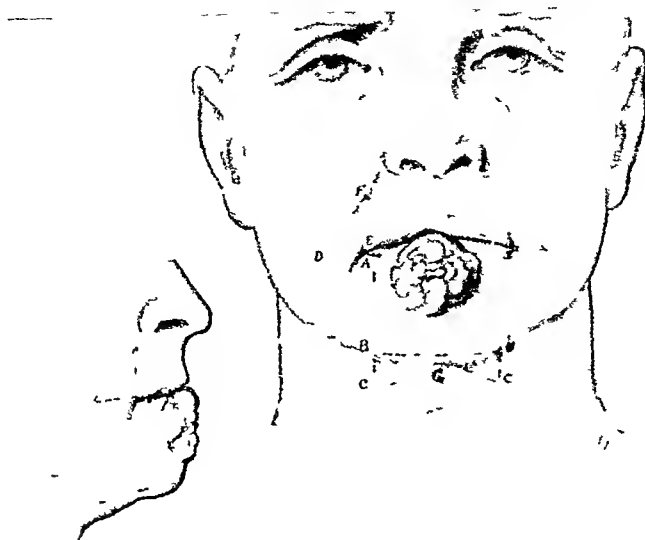


Fig 1 The incisions $A B$ and $a' b'$ from the vermilion border of the lip should be placed at least 1 centimeter beyond any visible or palpable evidence of the disease. The rectangle $A B b' a'$ outlines the first mass of tissue excised. The flap $B b' C c'$ is left attached until the end of the operation when it is trimmed to fit the triangular defect which remains in the submental region. Note that the incisions $A C$ and $a' c'$ appear as straight lines when viewed from the front but curved posteriorly when viewed from the side.

care at this point to avoid severance of the facial vessels, but ligation of the facial artery seems to have no marked effect on healing. I have twice accidentally severed the facial artery and observed no impairment in the nutrition of the flap.

The next step is to excise triangles of tissue above and lateral to the labial commissures (Figs 1, D , E , F , 2, and 5). These triangles should both first be outlined on the skin by very superficial incisions so as to assure their identical size and position. The mesial side of each should follow quite closely the direction of the nasolabial groove, for the subsequent scar is less noticeable if it falls within this natural fold (Fig 6). The mesial side of the triangle is thus inclined slightly mesially and is shorter (2 centimeters) than the lateral incision (2.5 centimeters). The base of the triangle is horizontal and in line with the commissure. Its length (2 to 2.5 centimeters) will vary with the amount of lower lip sacrificed. As these triangles are excised, the mucosa is left attached to the base and later turned forward, trimmed, and sutured to form the vermilion border of the new lower lip (Figs 2, 5, and 6).

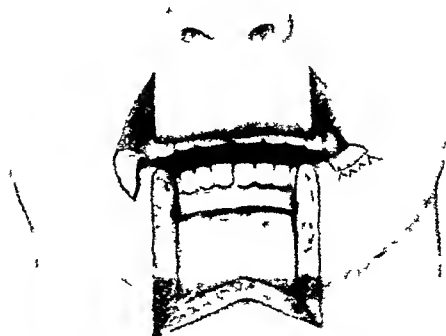


Fig 2 Diagrammatic representation of all tissue excised during the operation. On the right the mucous surface of the Bernard's triangle is shown attached at its base ready to be trimmed to form a new vermilion border. On the left this has already been done.

of the mandible (Figs 1 2 and 3) If due to a wide extent of the growth they must begin lateral to the labial commissures the incisions may be inclined mesially to a slight extent These vertical incisions from the vermilion border down to the lower edge of the mandible form the free ends of the two cheek flaps (Fig 1 A B and a b) From the lower edge of the mandible the incisions should continue directly backward in the sagittal plane so that when viewed from the front each incision from the vermilion border down on to the neck is a straight line Viewed from the side the incisions appear to curve obliquely backward from the lower edge of the mandible (Fig 1) Below the lower border of the mandible the incisions form the lower edges of the cheek flaps Their lengths will depend on the amount of mobilization required

The direction of the incisions below the edge of the mandible is of extreme importance Illustrations usually show such incisions as following the course of the lower edge of the mandible which is not horizontal but inclined upward and posteriorly A plane parallel to the lower edge of the mandible will meet a horizontal plane through the labial commissures at about the angle of the jaw A flap cut with its lower edge along the lower mandibular border will therefore be too narrow and taper toward its base which is in violation of all plastic principles Furthermore this portion of the healed scar is almost invisible in the submaxillary and submental regions and is much foreshortened by the apposition of the flaps in the midline

Near the close of the operation when the commissures are being repaired it will be found that the portion of the cheek which forms the new commissure is of too great thickness This lesser difficulty can be solved by the excision of a portion of muscle and fat

The hygienic condition of the oral cavity should be attended to before operation Any markedly carious or loose teeth should be extracted and if pyorrhoëa is present the teeth should be gently scaled by the dentist However gross trauma to the gum margins by wholesale extraction of teeth or too energetic treatment of pyorrhoëa is to be avoided Such measures defeat their purpose by substituting an acute inflammatory condition in place of a chronic one The best cosmetic results are obtained when both upper and lower incisors and cuspids are preserved Just before going to the operating room the patient is given a few cubic centimeters of full strength Dakin's solution which he is told to hold in his mouth for 2 or 3 minutes.

TECHNIQUE

The most satisfactory anæsthetic for this type of operation is conduction anæsthesia the technique of which is not difficult to master and is clearly described by Labat Two per cent novocain block of both third divisions of the fifth cranial nerves and of both infra-orbital nerves will anæsthetize all of the operative field except to some extent the rather limited incisions below the lower borders of the mandibles where local infiltration is sufficient Conduction anæsthesia is quite satisfactory and avoids the postoperative complications of a general anæsthetic It permits the patient to assist in expelling blood clots from the oral cavity which prevents their aspiration into the trachea The patient is also able to follow directions in opening or closing the mouth as necessitated by the various steps of the procedure

The operation is begun by two incisions which are made from the free border of the lip downward to the lower border of the mandible (Fig 1 A B and a b) These incisions should be at least 1 centimeter lateral to any visible or palpable evidence of disease If an assistant compresses the full thickness of the lip with thumb and forefinger hæmorrhage is only moderate A third incision is next made in the bottom of the gingivobuccal gutter and the dissection is rapidly carried down thus freeing the tissues from the mandible anteriorly removing periosteum if there is a question of deep invasion When the dissection has reached the lower border of the mandible the flap thus formed is excised by a horizontal incision (Figs 1 B b and 3) The skin of the submental region is left to be adjusted to fit the closure in the final stages of the operation

Next the two horizontal incisions are continued directly backward as viewed from the sagittal plane for about 3 to 4 centimeters (Figs 1 B C and b c 2 and 4) They outline the lower edges of the two late alplastic flaps Mobilization of these lateral flaps necessitates next the incision of the mucosa in each lower gingivobuccal gutter (Figs 4 and 5) These mucosal incisions are carried back to or beyond the last lower molars or even up along the anterior borders of the ascending ramus The lateral flaps are then freed from the outer surfaces of the horizontal ramus by sharp dissection close to the bone through the muscular attachments as far back as the anterior edges of the masseters The flaps should then be stretched forward to see if they will meet in the midline without undue tension and if not the masseteric insertions into the mandible may be detached by a periosteal elevator Good technique demands

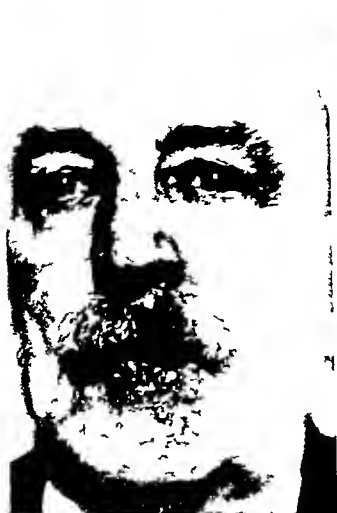


Fig 7A



Fig 7B



Fig 7C



Fig 7D

Fig 7 Case J.R. Deeply infiltrating squamous carcinoma of the lip without metastasis. The disease extends from the vermilion border of the lip almost to the point of the chin. A, Condition before operation, B, 24 hours after the operation (July 27 1928), C and D, condition 1 month after operation. This patient lived for 3 years without any evidence of recurrence, and died of other causes.

Fig 8 Case P.A. Deeply infiltrating carcinoma of the lip presenting chiefly on the inner surface and extending down into the gingivobuccal gutter. There were no metastases. A, Condition before operation, B, 24 hours after operation (October 8 1928), C, 6 months after operation. This patient is living and free of disease, 4 years after operation.



Fig 8A

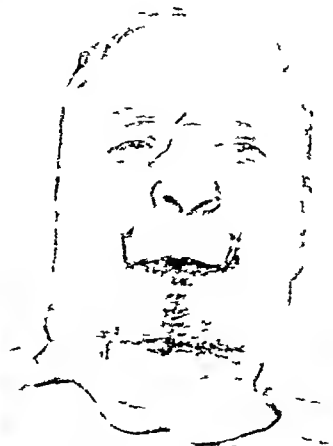


Fig 8B



Fig 8C



Fig 3. The distal flap is reflected with the lip and chin. The patient is held in the position shown. The incision is made on the lingual side of the lower lip.



Fig 4. The distal flap is reflected with the lip and chin. The patient is held in the position shown. The incision is made on the lingual side of the lower lip.

Closure is begun by suture of the incisions in the lower gingivobuccal gutters. The first stitch is placed entirely on the gingival side at the posterior limit of the incision (Fig 5). Subsequent

sutures are placed about one half centimeter anterior on the gingival than on the buccal side and as each is tied the incision is stretched more



Fig 5. A schematic diagram of the lower lip and chin. The incision is made on the lingual side of the lower lip.

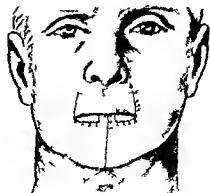


Fig 6. The distal flap is reflected with the lip and chin. The patient is held in the position shown. The incision is made on the lingual side of the lower lip.

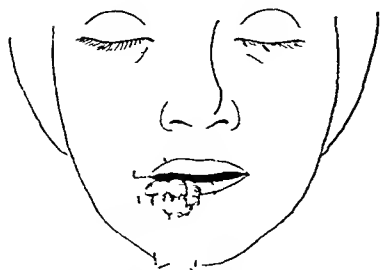


Fig 11A

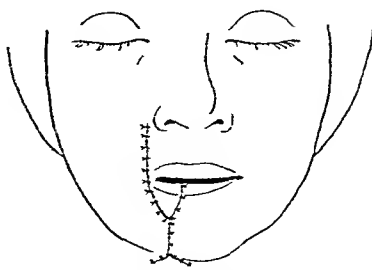


Fig 11B

Fig 11 A modified operation for carcinoma of one half of the lower lip invading one commissure. One Estlander triangle is brought down to help fill the defect. The narrowed mouth on one side may be corrected by a later plastic.



Fig 12A



Fig 12B



Fig 12C

Fig 12 Case L D A Carcinoma of the lower lip invading a little more than one half of the right side and extending beyond the right commissure. There were no metastases. B, Twenty four hours after operation (February 18, 1931). One Estlander triangle has been brought down to help fill the defect which is partly closed by sliding a flap from the left. C, Healed condition. This patient is living and free of any sign of recurrence about 1 year after operation.

and will fall smoothly into place (Figs 6, 7B, and 8B).

Sutures of medium dermal are most satisfactory and may be used throughout, although the heavy size may be of advantage in cases in which extra tension is required, and the fine for very superficial approximation. This suture material combines strength and flexibility to a marked degree. The eversion stitch (sometimes called the inverted mattress stitch) should be used if the skin or mucosa tend to invert (Fig 5 4). As in all plastic surgery, the cosmetic appearance of the scar depends on accurate approximation of the skin edges.

VARIATIONS IN TECHNIQUE

If the growth extends widely on the inner surface of the lip and on to the alveolar ridge, a segment

of the upper border of the alveolar ridge and mandible may be removed by a motor saw. In such cases, the mucosa of the floor of the mouth is readily drawn forward and sutured to the mucosa of the lateral flaps so as to cover the exposed bone. In one case, a wide segment of involved bone was so removed leaving a portion of the lower border of the mandible only about 1.5 centimeters wide to maintain the mandibular arch. The patient has been free of disease for over a year. In such cases, the tissues of the chin are not so well supported and a less satisfactory cosmetic result is obtained.

If the growth involves the entire lower lip or extends beyond the commissures, the vertical incisions must be more laterally placed and should be inclined slightly mesially. So much tissue is



Fig 9A

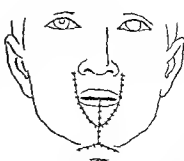


Fig 9B

Fig 9 A m d f d pla f p t f r carcin m f th l p t ding t
b j d th m m u t i l i n g E t l a n d f l a p m m u a l l y p l a c d i h l p
c l s e t h s a r i l y d d f e c t T h m t h i s t h b y m c h a r e d a n d
c o d p l u s h o l d b d o t d t



Fig 1



Fig 2



Fig 3

Fig 3 C s e A B A B l k y c m m f th l p t ding l u b j d b o t h l a b l m a r w a t e s T h
m t t a s e B T t y f h a f t p e t s s h w i n g t h s e f e t l a d f l a p (A p r i l 6 9 3) C a f t e s e c d
p l t f t w d t h m t h T h u p l t d i d 6 m t h a f t p e r a t f t h e r s e s T h t n o e c e r r o c f t h e
d s e s e t t h t m f d t h

and more anteriorly so that eventually its tip will reach the midline. Great care must be taken that the mucosa does reach the midline anteriorly as any raw surface within the mouth spells failure from the standpoint of a perfect result. After suture of the mucosa to about the position of the cuspid tooth the mucosal side of the triangle should be sutured after which the closure of the opposite side is brought to the same stage of completion (Fig 5). Suture of the flaps, the anterior gingivobuccal gutter is next done continuing up the midline and over the free border of the lip along the skin edges to the point of the

chin. The vertical wounds above the commissures are then closed and mucosal flaps from the triangle angles trimmed and sutured over the raw surfaces of the new lower lip. In adjusting the angles of the mouth a more natural appearance of the commissures is obtained if the thickness of the cheeks is lessened at this point by the excision of a wedge of muscle and fat.

The last stage of the operation is the adjustment of the submental skin flap which will be found to be excessive following the drawing forward of the lateral flaps. The skin and superficial tissues are trimmed in the form of an inverted Y

FROM THE LAHEY CLINIC

RESECTION OF THE RIGHT COLON AND ANASTOMOSIS OF THE ILEUM TO THE TRANSVERSE COLON AFTER THE PLAN OF MIKULICZ

FRANK H LAHEY, M D, F A C S, Boston

INTESTINAL suture, particularly when it involves suture of the colon, is a procedure of quite uncertain outcome even in the hands of men with considerable surgical experience and well developed technical skill. This is particularly true in intestinal suture dealing of the proximal colon, for this portion of the colon is filled with liquid feces and in it exist organisms of high virulence—factors predisposing to contamination and infection.

Anatomically the colon with its irregularity of outline due to its sacculations and its longitudinal bands, with its fat tabs of epiploic appendages, does not lend itself well to intestinal suture by end-to-end, end-to-side, or even side-to-side anastomosis. End-to-end anastomosis of ileum to transverse colon is made difficult and at times impossible with any degree of safety by the disproportion of the caliber of the two tubes of bowel. Lateral or end-to-side anastomoses possess not only the danger of leakage and soiling at the anastomotic suture line but also the danger that the blind ends of the colon may slough out and leak as the result of pressure upon them during post-operative distention. With the idea of overcoming these dangers, we have employed the method here described whereby the entire right colon, and, if necessary, part of the transverse colon may be freed, its mesentery ligated, and the colon removed between clamps aseptically by cutting between the clamps with a cautery and sterilizing the cut ends of the bowel. The two cut ends of bowel may then be implanted into the wound after approximation of the two laterally contacted loops consisting of ileum and colon, to form the double barrelled loop, after the plan of Mikulicz.

A description of the operative plan together with illustrations demonstrating the method is submitted, not with the idea that the method may entirely supplant present methods of preliminary lateral anastomosis and later resection or even primary resection and anastomosis, but because the method is a very safe way of removing the right colon and, if desired, also the hepatic flexure. The method is safe because it eliminates almost entirely the danger of leakage and peritonitis, and because by the scheme which I have

suggested (which may be original although that is not important), that is, the staggering of the two intestinal tubes so that the ileal tube is longer than the colonic tube, it is possible to bring about immediate ileal drainage and relief from intestinal obstruction without contamination of the wound.

THE OPERATIVE PLAN

A right rectus incision is made through the abdominal wall and the ascending colon is palpated to discover the location of the growth, its removability, and whether or not liver metastases are present.

If the condition proves to be favorable for resection, the right rectus incision is lengthened upward and downward sufficiently to obtain good exposure of the entire ascending colon and hepatic flexure. The parietal peritoneum external to the ascending colon is cut, as has been suggested by W J Mayo, and the entire colon is mobilized and turned inward so that it hangs by its mesentery

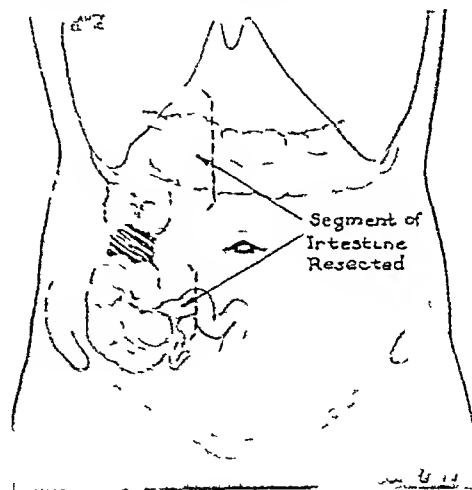


Fig 1 This diagram shows in the ascending colon in the shaded area, the location of a supposed malignancy of the right colon. The segment of ileum, ascending colon, hepatic flexure, and transverse colon which is removed by the plan of procedure here suggested, are shown, all bowel, as indicated by the arrow, external to the dotted line, being excised.

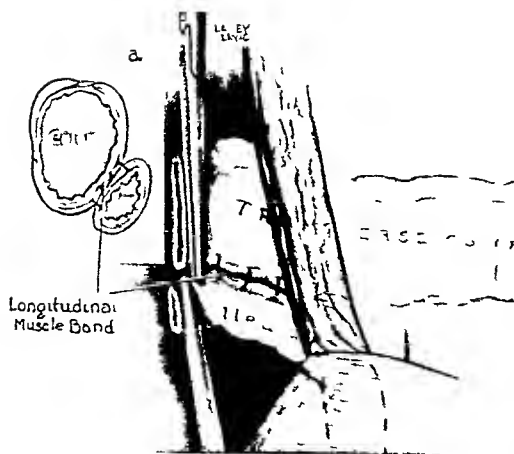


Fig 3 This diagram shows the ileum placed beside the transverse colon and approximated to it by tacking sutures so that a long double barrelled spur is formed between the two loops of intestine. In insert *a* is shown diagrammatically the method of approximating the ileum to the longitudinal band of transverse colon by anterior and posterior tacking stitch.

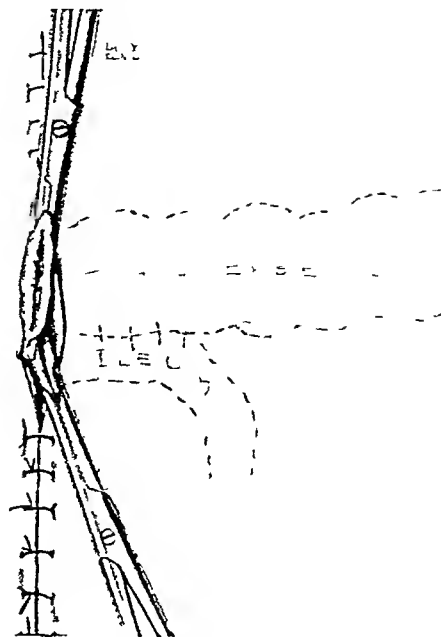


Fig 4 Diagrammatically one may see outlined through the sutured abdominal wall the ileum approximated, as shown in Figure 3, to the transverse colon. The ends of the colon and ileum are implanted, in the wound, still closed by the Ochsner clamps and having been sterilized by the cautery. The abdominal wound is sutured in layers snugly about the implanted ends of ileum and transverse colon. These clamps will keep the wound clean and uncontaminated until they slough off which is on about the fourth to sixth day, by which time there will be sufficient sealing in of the wound so that contamination will not take place.

gut, care being taken to place the ileum along the band of longitudinal fibers of the colon (Fig 3), and the abdominal wound is closed in layers about the clamped ends of bowel (Fig 4). Approximation of the ileum to the colon should be of sufficient length that a fairly long, double barrelled spur will result. This will provide a deep partition, the cutting through of which later with the severing clamp (Fig 6) will provide a wide opening through which the faecal stream will be re-established.

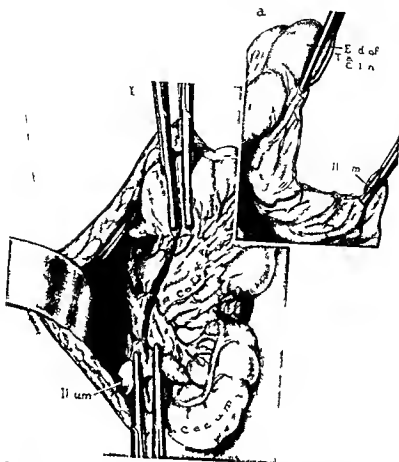
If, due to obstruction, there be any likelihood that immediate drainage from the ileal loop will be necessary, a loop of ileum considerably longer than that of the colon is brought out for a distance of 3 to 4 inches above the level of the abdominal skin and so also 3 to 4 inches above the level on the abdominal wall at which the cut end of colon is placed. The two loops of bowel colon and ileum are now approximated just as described and implanted in the wound by closing the peritoneum, fascia, and skin about the clamped ends of colon and ileum. The loops now appear as in Figure 5. No sutures are inserted between the parietal peritoneum and the bowel wall because of the danger of the stitch in the bowel wall penetrating too deeply, producing leakage, contamination, and peritonitis. Sealing off of the peritoneal cavity about the loops of the enterostomy takes place in a few days very satisfactorily without sutures.

When possible, the laterally approximated ileum and colon should be implanted in the lower angle of the abdominal wound since this portion of the abdominal wall and its anterior parietal peritoneum is lax and movable and permits of easy freeing and closure of the temporary enterostomy at the second operation. This is not absolutely essential, however, as we have implanted the cut end of the ileum and colon satisfactorily in the upper end of the wound.

If both cut ends of bowel, colon, and ileum have been placed at the same level, conditions will be as represented in Figure 4.

If the ileum and colon have been staggered as suggested and described in the text so that a longer segment of ileum projects above the skin level than does that of the colon, then conditions will be as represented in Figure 5.

Should it seem desirable now with the ileum staggered and the wound completely sutured to



in which are its nourishing vessels. This vessel of the ascending colon in its mesentery is ligated as close to the root of the mesentery as needed and the ligation of the mesentery is carried up to whatever point in the transverse colon permits of a margin of safety between the growth of the descending colon and hepatic flexure. At this point the two Ochsner clamps (Fig. 2) are applied. In the same manner ligation of the mesentery of the ileum is carried up to a point a sufficient distance away from the ileocecal valve so that two Ochsner clamps can be applied thereby identifying it with the colon (Fig. 3). With a safety the

ileum is severed between the clamp the entire segment of right colon and its short segment of attached ileum being freed. The proximal end of cut colon in the upper clamp is disinfected in the local one are thoroughly sterilized with the cautery and the tube of ileum and colon are brought up to the wound and placed in a double-barrelled fashion side by side (Fig. 3) after the plan of Mikulicz.

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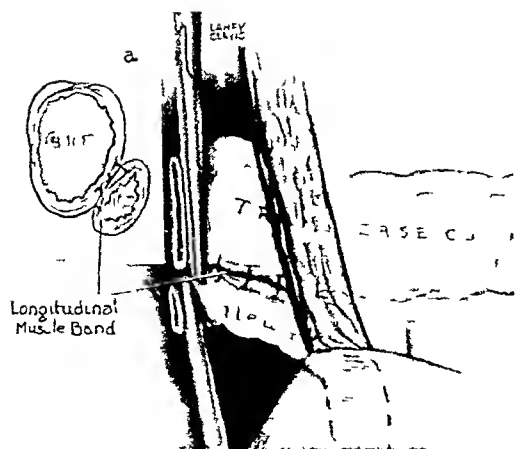


Fig 3 This diagram shows the ileum placed beside the transverse colon and approximated to it by tacking sutures so that a long double barrelled spur is formed between the two loops of intestine. In insert *a* is shown diagrammatically the method of approximating the ileum to the longitudinal band of transverse colon by anterior and posterior tacking stitch.

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If, due to obstruction, there be any likelihood that immediate drainage from the ileal loop will be necessary, a loop of ileum considerably longer than that of the colon is brought out for a distance of 3 to 4 inches above the level of the abdominal skin and so also 3 to 4 inches above the level on the abdominal wall at which the cut end of colon is placed. The two loops of bowel colon and ileum are now approximated just as described and implanted in the wound by closing the peritoneum, fascia, and skin about the clamped ends of colon and ileum. The loops now appear as in Figure 5. No stitches are inserted between the parietal peritoneum and the bowel wall because of the danger of the stitch in the bowel wall penetrating too deeply, producing leakage, contamination, and peritonitis. Sealing off of the peritoneal cavity about the loops of the enterostomy takes place in a few days very satisfactorily without sutures.

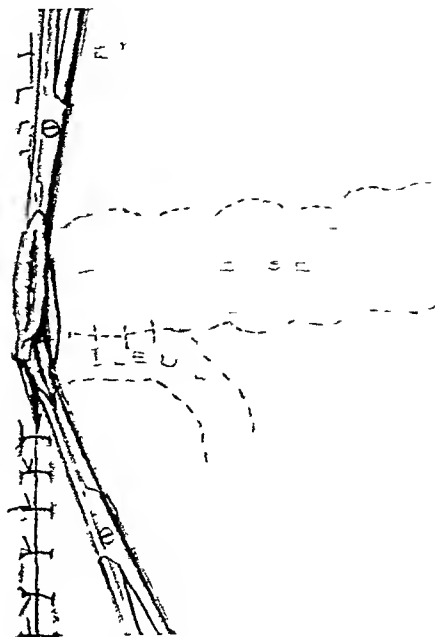


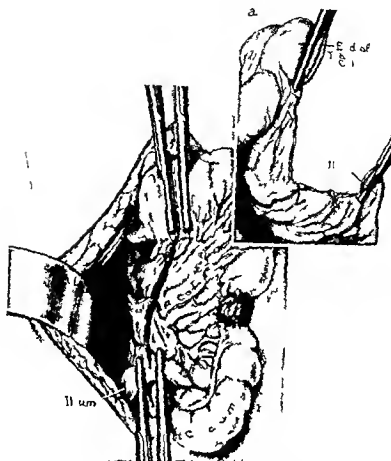
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When possible, the laterally approximated ileum and colon should be implanted in the lower angle of the abdominal wound since this portion of the abdominal wall and its anterior parietal peritoneum is lax and movable and permits of easy freeing and closure of the temporary enterostomy at the second operation. This is not absolutely essential, however, as we have implanted the cut end of the ileum and colon satisfactorily in the upper end of the wound.

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The external peritoneal pouch of the right flexure of the colon is used as a reservoir for the ileum. The mesentery of the ileum is ligated and the ileum is brought up to the surface of the abdominal wall. The ileum is then anastomosed to the colon. The segment of the ileum between the two clamps is removed.

in which are its nourishing vessels. These vessels of the ascending colon in its mesentery are ligated as close to the root of the mesentery as one desires and the ligation of the mesentery is carried up to the hepatic point in the transverse colon permit of a margin of safety between the growth of the ascending colon or hepatic flexure. At this point the two Ochsner clamps (Fig. 2) are applied.

In the same manner ligature of the mesentery of the ileum is carried out up to a point a few centimeters away from the iliocecal junction so that two Ochsner clamps can be applied side by side as with the colon (Fig. 2). With caution the

ileum is severed between the clamps the entire segment of right colon and its short segment of attached ileum being freed. The proximal end of cut colon in the upper clamp and ileum in the lower are thoroughly sterilized with the cautery and the tube of ileum and colon are brought up into the wound and placed in a double barrel fashion side by side (Fig. 3) after the plan of Mikulicz.

If no obstruction is present the two ends of colon and ileum are placed side by side at the same level on the abdominal wall and anastomosed by two rows of interrupted sutures. The

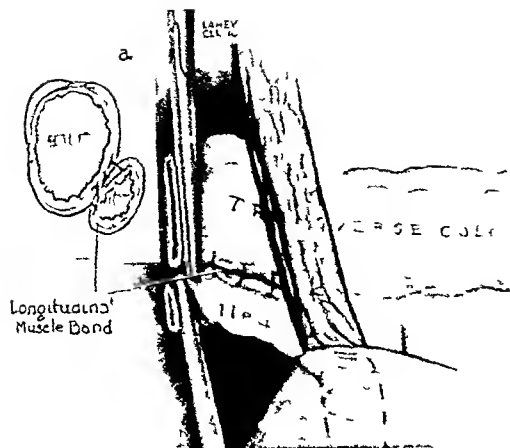


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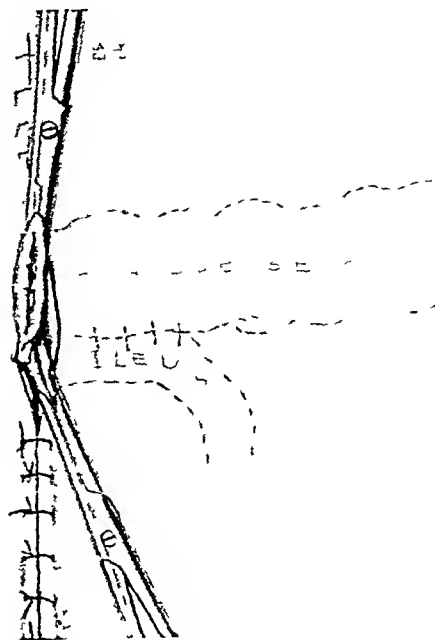


Fig 4 Diagrammatically one may see outlined through the sutured abdominal wall the ileum approximated, as shown in Figure 3, to the transverse colon. The ends of the colon and ileum are implanted, in the wound, still closed by the Ochsner clamps and having been sterilized by the cautery. The abdominal wound is sutured in layers snugly about the implanted ends of ileum and transverse colon. These clamps will keep the wound clean and uncontaminated until they slough off which is on about the fourth to sixth day, by which time there will be sufficient sealing in of the wound so that contamination will not take place.

When possible, the laterally approximated ileum and colon should be implanted in the lower angle of the abdominal wound since this portion of the abdominal wall and its anterior parietal peritoneum is lax and movable and permits of easy freeing and closure of the temporary enterostomy at the second operation. This is not absolutely essential, however, as we have implanted the cut end of the ileum and colon satisfactorily in the upper end of the wound.

If both cut ends of bowel, colon, and ileum have been placed at the same level, conditions will be as represented in Figure 4.

If the ileum and colon have been staggered as suggested and described in the text so that a longer segment of ileum projects above the skin level than does that of the colon, then conditions will be as represented in Figure 5.

Should it seem desirable now with the ileum staggered and the wound completely sutured to

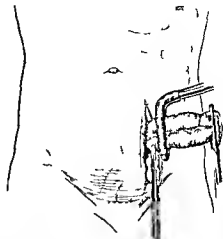
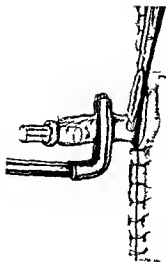


Fig 5. The clamp is applied to the cut end of the ileum and a glass tube attached to a large rubber tubing is tied into the cut end of the ileum. The rubber coated clamp is not released from the ileum and its contents are allowed to drain into a feed receptacle. This possibly original suggestion which is applied not only to the ileum but to the colon in Mikulicz procedure in the colon also has proven to be of great value (Fig 5A).

empty the ileum immediately sterile pads are placed over the wound and about the long ileal loop a rubber covered intestinal clamp is placed upon the loop of ileum close to the abdominal wall thus preventing the escape of gas and feces. The Ochsner clamp is removed from the cut ends of ileum and a glass tube attached to a large rubber tubing is tied into the cut end of the ileum. The rubber coated clamp is not released from the ileum and its contents are allowed to drain into a feed receptacle. This possibly original suggestion which is applied not only to the ileum but to the colon in Mikulicz procedure in the colon also has proven to be of great value (Fig 5A).

Fig 6. The clamp is applied to the cut end of the ileum and a glass tube attached to a large rubber tubing is tied into the cut end of the ileum. The rubber coated clamp is not released from the ileum and its contents are allowed to drain into a feed receptacle. This possibly original suggestion which is applied not only to the ileum but to the colon in Mikulicz procedure in the colon also has proven to be of great value (Fig 6A).

wound is sufficiently healed to resist contamination quite well.

If a long segment of ileum has been left it is at the end of a week away from the cautery and its vessels are contracted until it so adheres to the abdominal wall as is the implanted end of the colon in Figure 4.

At the end of a week or 10 days an Ochsner clamp is placed in the double bartered portion of bowel one jaw of the clamp being placed in the colon cecum and the other in the ileum. The two jaws of the clamp are pushed down so that the clamp grasps the greatest possible amount of the separation portion proximated at the first peristalsis and the jaws of the clamp are loosened (Fig 6). In 4 to 7 days this clamp comes loose and the new canal along which the fecal stream is to flow is established (Fig 6A). It is well at this point to send the patient home for 4 to 5 weeks. Part of the feces during this time will pass through the cut portion and so along the intestinal canal to the rectum. A considerable part however will still be discharged through the common intestinal opening of the ileum and colon to the abdominal wall.

At this interval which is disagreeable to the patient. Frequently the contents of the ileum are retreating to the knee and the patient is of course annoyed by the discharge of liquid feces into his abdominal wall since it is difficult to

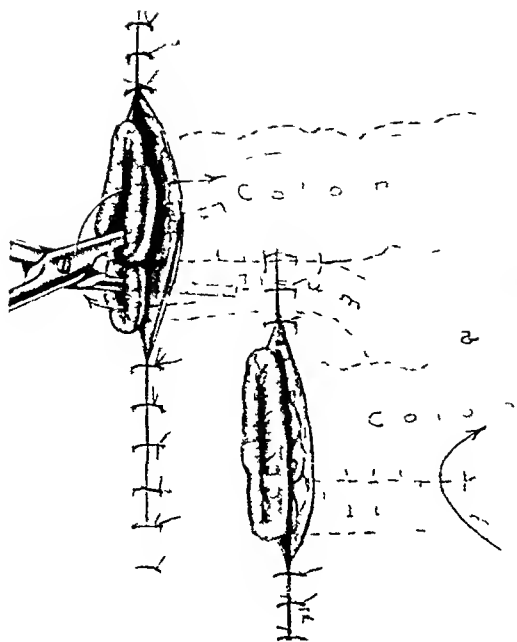


Fig 6 This diagram illustrates the end of the colon and ileum healed into the wound, the Ochsner clamps have sloughed off and the double barrelled spur is well established. In the main illustration on the tenth to twelfth day an Ochsner clamp has been inserted in the spur so that one jaw is in the colon and one in the ileum after the Mikulicz plan. The clamp is closed and cuts through the partition in from 5 to 6 days thus establishing the faecal stream along the colon as shown in insert a by the arrow and a common external opening between the ileum and colon, as shown in insert a.

impossible, to catch ileal contents in any kind of a bag or container.

It is desirable not to attempt closure of this common colonic and ileal enterostomy opening earlier than 4 to 5 weeks and better still, 5 to 6 weeks, since it takes this time for œdema to leave the deep portions of the wound and at the end of this time parietal peritoneum has become firmly attached to the limb of colon and ileum, and there is no danger of detaching it in the manipulations of the second closure of the Mikulicz spur and the re-establishment of the faecal stream.

At the end of 4 to 6 weeks, the patient is taken to the operating room for extraperitoneal closure of the common ileal and colonic enterostomy which has been produced by the cutting of the partition of the Mikulicz spur.

At this stage, we have been considerably disturbed by the irritated condition of the skin about the enterostomy spur. A few days may be spent in attempting to improve it with oint-

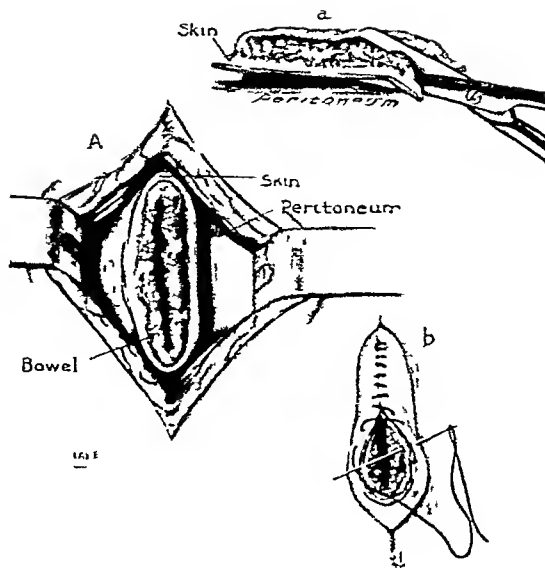


Fig 7 The main illustration A shows a thin strip of skin still adherent to the mucous edge of the enterostomy. Skin, subcutaneous fascia and muscle dissected away from the common enterostomy made by the ileum and transverse colon with their partition severed. Note that the peritoneum is unopened, still attached at the neck of the tube of bowel. Insert a shows adherent skin and mucosa being trimmed away to refresh edges preparatory to inverting and closing the opening of bowel. Note again the peritoneum is still unopened. In insert b, the edges of the enterostomy have been refreshed. Any bleeding vessels have been ligated and the bowel is now being inverted by a continuous Connell suture with the peritoneum unopened and the peritoneal cavity is thus in no danger of contamination. Following introduction of the first row of inversion stitches a second reinforcing row further inverting the segment of bowel but with the peritoneal cavity still unopened, is inserted.

ments and powders but if it does not improve, the secondary closure is immediately undertaken regardless of the condition of the skin. The procedure is to be entirely extraperitoneal. Infection of the wound to some degree is to be anticipated and expected and drains are to be placed in either angle of the wound with this particularly in view. For these reasons, no matter how angry the skin may look about the wound, the secondary closure may be proceeded with. As soon as the enterostomy opening is turned in, the skin is no longer irritated by the discharge of ileal contents and clears up at once. Furthermore, the irritation of the skin is largely of chemical origin and not due to infection.

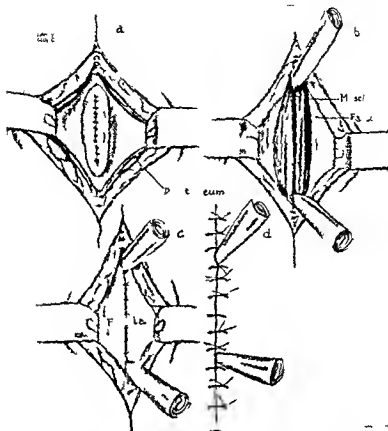


Fig 8 a. The first myotomy is made by the M. culci spurs. The hernia is then cut deeply enough so that there is plenty of room for the intestinal content to pass into the colon. An incision is then made in the skin around the entire ostomy opening about one fourth to one half an inch from the point where the bowel mucosa joins the skin. This incision is carried into the fascia of the rectum and the separated from the projecting tube of common ileum and colon. The Rectus muscle is now like is separated from the tube of bowel (Fig 7 b). At this stage then we have the tube of common ileum and colon projecting up at the end of the abdominal wall with the parietal peritoneum of the abdominal

At the second closure of the enterostomy it is first made certain that the M. culci spurs are between the colon and ileum has been cut deeply enough so that there is plenty of room for the intestinal content to pass into the colon. An incision is then made in the skin around the entire ostomy opening about one fourth to one half an inch from the point where the bowel mucosa joins the skin. This incision is carried into the fascia of the rectum and the separated from the projecting tube of common ileum and colon. The Rectus muscle is now like is separated from the tube of bowel (Fig 7 b). At this stage then we have the tube of common ileum and colon projecting up at the end of the abdominal wall with the parietal peritoneum of the abdominal

v all firmly adherent to its neck and hutting it entirely the peritoneal cavity (Fig 7 c). The original enterostomy opening is then a strip of attached skin which was taken in the original incision of the sac. The edge is not trimmed away (Fig 7 a) together with any redundant length of the common intestinal tube made up of the colon and ileum. A bleeding tube is in the freshly cut edges of the enterostomy opening are clamped and attached and an incision and a Corneal urethra closes the opening which as the temporary artificial anus (Fig 7 b). Thus row of clamping is reinforced by another row of sutures, the first row (Fig 8 a). Two pieces of rubber dam are placed over the sutured bowel one being brought

out at the upper end of the wound and one out at the lower end of the wound. The fibers of the divided rectus muscle are approximated by suture over the drain and sutured bowel (Fig 8, *b*). The rectus fascia is closed over the muscle (Fig 8, *c*) and the skin likewise closed with the rubber dam drains emerging from the upper and lower angles of the wound (Fig 8, *d*).

A moderate degree of infection takes place in most of the wounds but since the repair is all extraperitoneal this occasions no worry and is cared for satisfactorily by the drains at the upper and lower wound angles.

There may and occasionally will be a slight discharge of feces from the wound, but if the spur has been deeply cut so that there is plenty of room for ileal contents to pass into the colon, spontaneous closure of the fistula takes place.

ADVANTAGES AND DISADVANTAGES

The drawbacks to this operation are the length of time in the hospital involved, about 3 weeks for the first operation and about the same or a little less for the second, the fact that it is a two stage procedure requiring two operations, although the second being extraperitoneal, is not particularly troublesome, the presence of an artificial anus for 4 to 6 weeks, and the irritation of the skin which frequently results from contact with ileal contents.

The advantages are that liquid ileal contents pass readily over through the cut spur opening into the colon. Immediate drainage of the ileum for moderate intestinal obstruction, if desired, by the plan here suggested of staggering the ileum, may

be obtained without contamination of the wound. The entire growth and its adjacent mesentery can be aseptically resected and removed at the first operation and without limitation as relates to blood supply of mesentery and the danger of peritonitis from leakage. The bugbear of all anastomoses in large intestine, leakage and peritonitis, is practically eliminated. This operation removing as it does the entire growth with adjacent bowel at the first operation is not subject to the dangers of implantation of the cancer in the wound as is the case in the original Mikulicz operation in which the bowel with contained cancer is not cut away between clamps as here described, but is approximated into two limbs and left in the wound to be cut away at a later operation.

As I have viewed the experiences of patients with this operative procedure in the rather limited number of cases in which it has been applied, ten in number, I am convinced that were it necessary for me to submit to right colectomy, I would unhesitatingly accept the inconveniences and delays associated with this operation rather than the more time saving, less troublesome but more risky features of primary resection and anastomosis. I most certainly would prefer it to preliminary lateral anastomosis and later resection with the necessity of harboring an unresected and disseminating cancer between the first and second operating stages. It is a much less difficult operation to do from a technical viewpoint and one, therefore, which is safer than primary anastomosis both in the hands of men of great or of moderate experience.

INTERSTITIAL PREGNANCY¹

V J & J E ASH MED. L. C. OF U. S. A. M. W.
C. A. M. & Museum

INTERSTITIAL pregnancy is of more than academic interest even to the general practitioner. It is one of the out of the ordinary conditions of which it is tritely stated that it occurs more commonly than is supposed. A case report furnishes the opportunity to review the story of the condition for the benefit of those who do not have the time or the facilities to read the special literature. No attempt will be made to analyze critically this literature. Those who are interested will find it covered from 1669 to 1903 by Weinbrenner and to 1930 by Veit and Weber, Lequeux, Wynne, Blagodarow, and especially Hochne.

Interstitial pregnancy is one that occurs in that portion of the oviduct that passes through the uterine muscle. There is considerable discussion in the literature over a subdivision into intramural and intracanalicular forms; the former term properly given when the ovum develops in the uterine muscle outside of the tube and the latter when the ovum develops solely within the tubal lumen. There is no practical significance to this differentiation however and as a matter of fact it is unlikely that either occurs in pure form. The very nature of the conditions preclude the likelihood of the tube remaining intact for very long after implantation of the ovum. Though the tube plays a part in the formation of the sac, it must soon lose its identity by compression and erosion. True intramural pregnancy, one that develops in the muscle leaving the tube intact and patent must be rare. Raschke says that no such case had been described up to 1903.

However the following classification based on the site of implantation of the ovum has practical significance as to the outcome of the case depends somewhat on the localization.

1. Utero-interstitial when the ovum implants in the third of the tube adjacent to the uterine cavity.

2. Tubo-interstitial when the ovum implants in the uterine third.

3. True interstitial when the ovum implants in the middle third.

This classification is similar to that of Veit and Weber, of Scott of Weinbrenner and of Hochne.

INCIDENCE

Interstitial pregnancy is rare but it does occur more frequently than either ovarian pregnancy

abdominal pregnancy and it is very likely that the incidence is keeping pace with the increase in the general group of ectopic pregnancies. There is probably a maximum of one report of cases that will withstand critical analysis as to the accuracy of diagnosis. It is likely as Hochne suggests that a number of cases that have reported have been diagnosed as incomplete uterine abortion and curetted and the rupture attributed to the curette. Such a situation by the way may be of medical-legal importance as is illustrated by Maschka's case in 1885 and by several others since.

Figure 1 illustrates the relative frequency of the various forms of ectopic pregnancies.

ETIOLOGY

There is a surprising variation in the nativity of the interstitial portion of the tube. While in some cases the tube runs a straight course, more commonly has a bow with the inflexion at the upper and posterior ends of the cornua. As a further complication there may be definite sharp bends. In Blagodarow's first case there were 5 such kinks in the unaffected tube and he attributed the arrested passage of the ovum to a similar condition in the affected tube.

The tubal narrowest points are usually average in diameter not more than 0.8 millimeter. The impregnated ovum increasing in size during its passage down the first portion of the tube may be mechanically blocked on each of the constrictions. The mucosa of the upper part of the tube is normally the thinnest and is free from folds but a case may be thicker than normal and resemble endometriosis. There may be definite adenomatous hyperplasia particularly at the bends where there may be diverticula and polyps in the mucosa. Any of the deviations from the normal may determine the site of implantation.

In addition to the anatomical peculiarities inflammation may play an important role. An ectodermic may so compress the uterine mouth that the tube is thick while perimetrium may enter the tube the ovum can not escape. Salpingitis may extend into the interstitial portion of the tube and further reduce its lumen by exudate by exfoliation of epithelium particles during menstruation or by adhesion. This is the basis of the anatomical color of the ovum in the tube from the uterus for the same conditions.

¹ From the Army Medical Museum, Washington, D. C.

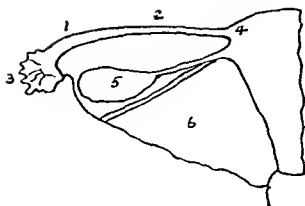


Fig 1 Diagram to show the relative incidence of the various forms of ectopic pregnancy 1, Ampullar, 2, isthmian, 3, infundibular, 4, interstitial, 5, ovarian, 6, primary abdominal (After Kerr and Ferguson)

exist in the free portion of the tube, and they will probably arrest the ovum that enters from the abdominal cavity before it reaches the interstitial portion

That impregnation of the ovum can occur in the abdominal cavity is proved by the cases of pregnancy in rudimentary horns, since the latter have no communication with the uterine cavity. An ovum, particularly if from the opposite ovary, impregnated in the abdominal cavity, may grow too large to pass through the interstitial tube by the time it has traversed the abdominal cavity and the free portions of the tube

Scott attributes his four cases to the curettage that had been performed on each one some time before the interstitial pregnancy had developed. A number of the other cases had previous pelvic operation. Intramural myomata may compress the tube sufficiently to prevent passage of the ovum, or possibly the ovum impregnated in one tube may traverse the uterine cavity and enter the opposite tube, by which time it has grown too large to force its way beyond the interstitial portion

Interstitial pregnancy occurs most commonly in multipara between the ages of 25 and 35 years. A few more cases have been reported as occurring on the right side than on the left, and Wolf wonders if appendicitis may not be an etiological factor, but there is no evidence to support the conjecture

An occasional case of bilateral interstitial pregnancy has been reported, one of them by Woolf. Of particular interest are the ones occurring in the stumps remaining after salpingectomies. Richardson reports one such case, and he was able to collect seven others from the literature, including Nache's case in which interstitial pregnancy occurred 3 months after he had attempted sterilization of his patient by removing both tubes. The stumps had, of course, become patent, but it is a question whether the ovum had entered through the uterine or the abdominal end. Richardson credits the latter route under these conditions



Fig 2 Interstitial pregnancy 1, Adherent omentum, 2, right ovary, 3, gestation sac containing collapsed amnion and placenta 4, rupture, exposing placenta, 5, edge of communication between sac and uterine cavity, 6, arrow points toward left cornu, 7, uterine cavity, 8, left ovary showing cross section of corpus luteum. There is some exaggeration of the difference in levels of attachments of the adnexa on the two sides (Army Medical Museum Accession No 30396 Negative No 47591)

PATHOLOGY

As has been intimated, the gross and microscopical pathology of interstitial pregnancy is largely dependent on the anatomy of the part. Because of the simplicity and thinness of the mucosa, there is little or no decidual reaction, so that on penetration, the ovum is practically always in direct contact with the uterine muscle. This latter the chorionic villi destroy, infiltrate, and compress in the line of least resistance which, on account of the location of the tube, is toward the superior and posterior of the involved cornu. With the growth of the ovum, the wall becomes gradually thinner, until after a few weeks it consists only of serosa, a few strands of connective tissue, and uterine muscle. This method and direction of enlargement is practically constant and is not dependent on the implantation of the ovum in the middle third of the tube. Naturally, when the ovum has implanted near the



Fig 3. Section through decidua and chorionic villi showing the arrangement of trophoblastic and decidual fibers (Army Medical Museum, No. 3396, Neg. No. 49346, X85).

uterine orifice and is expelled or escapes by rupture of the intervening septum into the uterine cavity the typical deformity of the uterus does not occur but then it is no longer an interstitial pregnancy.

The classical signs that are dependent on this location and direction of the enlargement are recognized to be of great importance in the anatomical diagnosis. These are:

1. The Ruge Simon syndrome which consists in the elevation of the affected cornu, the displacement of the fundus toward the opposite side, the rotation of the uterus on its long axis (due to pull of the round ligament) and the insertion of an intact tube into the inferior surface of the enlargement.

2. The Baart de la Faillie sign which is simply that the sac is attached to the fundus by a broad base. This is constant. A gestational sac attached to the uterus by a pedicle cannot be an interstitial pregnancy. But the Ruge Simon sign may not be apparent in very early pregnancy or when the uterus is fixed in position by adhesions. Its absence therefore does not exclude the possibility of an interstitial pregnancy.

In addition to these two signs the following points are significant: the round ligament is lateral to the sac, the round and ovarian ligaments and tube on the affected side move widely separated at their insertions into the cornu than are those on the opposite side and they are all at a higher level. The sac is separated from



Fig 4. Section of decidua and chorionic villi showing the arrangement of trophoblastic and decidual fibers (Army Medical Museum, No. 3396, Neg. No. 49385, X5).

the uterine cavity by a wall but it may communicate with the uterine cavity through the distended uterine orifice of the tube or through a break in the wall, the entire sac completely surrounds the sac and the isthmus of the tube is intact.

The uterus usually shows some general hypertrophy, the cervix may be soft and the canal be plugged with mucus as in normal pregnancy. Decidua may be present in the uterine cavity but it is not likely to be if the pregnancy is advanced or if the ovum has died. In the latter instance it is sequestered and bagged as it is in ordinary tubal pregnancy. Decidua may or may not be present in the wall of the sac and when present it is never massive. The Langhans cells from the villi may be mistaken for decidual cells. The pardecidua poses the muscle to attack by the villi which develop over the outer surface of the sac and can be seen going into the uterine muscle and infiltrating it. There is usually a certain amount of connective tissue reaction in the involved musculature. The muscle fibers may show the hypertrophy of pregnancy.

hile those adjacent to the villi will show regressive changes. The thin portion of the sac may be devoid of muscle, the villi seemingly imbedded directly on the peritoneum. The omentum and intestines are not infrequently adherent to the sac.

Pregnancy in a rudimentary horn can closely simulate an interstitial pregnancy, but in the former there is not the disturbance in position of the fundus (Ruge-Simon's sign), there are more apt to be vestiges of uterine mucosa and a decidual reaction about the sac, and there is less likelihood of a communicating opening between the sac and the uterine cavity. When there is such an opening it will be recessed, and the dividing wall will not bulge into the uterine cavity.

Pregnancy in one horn of a bicornate uterus can be differentiated by three points. The tube is attached to the lateral surface of the sac, there is a decidual reaction comparable to that of the uterine mucosa and the decidua extends into the tube, and the tube lumen, particularly in the early stages, communicates with the sac.

In tubal pregnancy, the involved tube is distorted, shorter than its fellow, and the sac may have a pedicle formed by the uninvolved portion of the isthmus. The round ligament is attached between the sac and uterus, except in pregnancy of the isthmus immediately adjacent to the cornu. In this last instance, the cornu may be passively enlarged by invasion of villi, and the round ligament will come off from the anterior surface of the sac. There will, however, be no disturbance in position of fundus, and the distal portion of the tube will be attached to the lateral aspect of the sac instead of to the inferior

his cases. Of course, palpation after rupture of the sac is difficult, and particularly so if the sort of base any recognizable mass might have is to be determined. It is suggestive to find the body of the uterus larger than it would be in a tubal pregnancy of the same age.

The symptoms both before and after rupture may be identical with those in a tubal pregnancy, and it is practically impossible to differentiate, particularly before rupture, from a pregnancy in a bicornate uterus or from one in a rudimentary horn. It is true that such general symptoms as abdominal pain, nausea, and prostration may recur over a longer period of time than they do in a tubal pregnancy, but at the time of rupture there is the same story of sudden, intense, lower abdominal pains, collapse, and evidence of internal hæmorrhage. The majority of cases give a history of irregular vaginal bleeding, but there is more likely to be amenorrhœa than in tubal pregnancy. On the other hand, there may be no interruption of the normal menses.

The discharge of fetal elements is, of course, important evidence for differentiating the abortion of a normal uterine pregnancy, and the pulse, temperature, and blood picture are useful in excluding an abdominal inflammation. There is finally the possibility of confusing a normal pregnancy in a laterally flexed uterus with interstitial pregnancy.

In spite of these difficulties in diagnosis, more cases will be recognized before rupture if clinicians will follow Braddock's and Scott's reasonable suggestion to keep in mind the possibility of an interstitial pregnancy when examining any woman in the child bearing age with any deviation from the normal menstrual cycle.

DIAGNOSIS

There is very little on which to base a clinical diagnosis of interstitial pregnancy. The review of a number of cases suggests a few vague points of differentiation, but these lose much of their significance when applied to the individual case. The diagnosis has been made but rarely before operation, or even suspected. The most suggestive point, in the presence of symptoms indicating pregnancy, is the palpation of a mass attached by a broad base to one cornu of the uterus, but in several cases in which such a mass was palpated, the diagnosis was made of a soft myoma in the cornu of a normally pregnant uterus. If one is fortunate enough to detect by a series of palpations the gradual enlargement of such a mass, a diagnosis can be made with greater assurance. Blagodarow reports such an experience in one of

COURSE

As might be supposed, in the majority of cases the diagnosis is not made until after the rupture, and because of the severity of the hæmorrhage, the mortality is approximately three times that of tubal pregnancy, if we accept Schumann's rate of 4 per cent for the latter. He cites, by the way, the decrease in mortality from ectopic pregnancy from 80 per cent in 1875. This is due to the improvement in surgical procedure, and to the lessened tendency to delay operation. There is no question but that interstitial pregnancy is the most dangerous form of the ectopic implantations, and this is due in part to the misleading lack of severity in the early symptoms in some cases.

Rupture in interstitial pregnancy occurs on an average 4 weeks later than it does in tubal pregnancy. Waegeli critically analyzed all the cases

an hour. No vaginal examination was made or any attempt at operation, though it was recognized at this time that she was suffering from a ruptured ectopic pregnancy.

Necropsy. Body was well developed and nourished, breasts were those of a well advanced pregnancy. The thymic mass was rather larger than normal for her age. There were approximately 2 liters of fluid and clotted blood in the abdominal cavity, and her tissues were practically exsanguinated. The omentum was firmly attached to the upper edge of the fundus and to the sac in the right cornu of the uterus. The anterior surface of the uterus was firmly adherent to the abdominal wall along the scar of the former laparotomy wound. The kidneys showed considerable degeneration.

Gross description (Fig 2). The uterus was generally enlarged, and the right cornu was distorted by a globular, sac like swelling 11 centimeters in diameter. The omentum was attached to this sac for a distance of 7 centimeters along the superior surface. On the left anterior surface was a rent 4 centimeters long through which chorionic villi protruded. The adnexa of the right side were attached at a level approximately 5 centimeters higher than were those of the left side, and bore the classical relationship to the sac, the round ligament lateral to the sac, the tube attached to the lower border. The left tube was 9 centimeters long, the right was 10.5 centimeters long. Both were of normal diameter, patent to the cornua and free from inflammation. The right tube did not communicate with the sac. The insertions of the left tube and round ligament were 1.5 centimeters apart, those of the right tube and round ligament were separated by 4 centimeters. There was a large corpus luteum in the left ovary, obviously the one concerned in this pregnancy.

On palpation through the rather roomy cervix before the uterus was opened, the finger entered a definite constriction. This was thought to be the internal os, but it proved to be an opening in the wall dividing the sac from the uterine cavity. It was 2.5 centimeters in diameter, and through it bulged a sizable portion of the amniotic sac. Its edge was thin, smooth, rounded, and of fibrous consistency, but the dividing wall expanded rather abruptly, became muscular, and merged with the fundus from which it was obviously formed. It was not possible, however, to determine whether the opening was a tear in the wall or the dilated uterine orifice of the right tube. The impression was that it was the latter. The sac contained an intact amnion in which floated a 5 to 6 months' male fetus with the cord wrapped three times about its neck. The fetus was well developed and in good condition, apparently having died shortly before the patient. A well developed placenta lined the sac, except in the upper and right lateral portions. The upper half of the sac was very thin translucent and apparently reduced to serosa, except where reinforced by the adherent omentum.

The wall of the remaining fundus was hypertrophied, averaging 2 centimeters in thickness. The cavity was roomy, measuring 4 centimeters from the internal os to the dividing wall of the sac. The left cornu could be identified extending upward to the left behind the dividing wall. The endometrium was thickened and quilted apparently from decidual reaction. The cervix was elongated, softer than normal, and its canal contained a mucous plug similar to that seen in a normal pregnancy. The mucosa of the cervix was also thickened and contained a number of small cysts toward the external os.

Microscopical findings. The wall at the site of rupture showed a few strands of hypertrophied muscle and some connective tissue. Internal to this was a thicker zone composed largely of decidual cells, and resting on this layer and attached to it were numerous chorionic villi

(Fig 3). The syncytial layer was usually missing over the surface of the villi attached to the maternal tissue.

The section taken from the posterior wall of the sac over the placental site, and at a point where the wall was very thin, showed practically no muscle and no decidual reaction. A thick layer of necrotic material in which an occasional villus could be recognized was attached to the inner surface. There apparently had been a subplacental hemorrhage at this point. No decidual reaction was seen in blocks from the anterior wall of the sac near the insertion of the right tube, and at no point was real invasion of the uterine muscle by villi encountered.

A section from the fundus where it was split by the sac showed villi penetrating superficially a layer of semi-necrotic material, and here they were in contact with maternal blood. Deeper in, were larger blood spaces, but no villi.

The inner surface of the fundus showed some scattered foci of decidual-like cells, but generally the mucosa was missing, and there was a thick layer of partially necrotic tissue containing groups of nuclear fragments, but no glands were seen. A uterine decidua had evidently formed and had been discharged. Beneath this layer were large blood spaces, and the musculature of the entire fundus and cervix was hypertrophied. The mucous glands of the cervix were active, and the epithelium in places showed a transition into decidual-like cells.

This case presents the classical gross features of an interstitial pregnancy which persisted beyond the common age of rupture. It is probable that the adhesions protected the sac from an earlier rupture, and they prevented a very marked degree of lateral displacement of the fundus. The character of the opening into the uterine cavity and the patches of decidual reaction in the wall of the sac indicate that implantation was intracanalicular and not intramural and that the sac was primarily in the tube lumen, although the tube lost its identity and its mucosa was largely destroyed during the growth of the fetus.

It is doubtful if the uterine adhesions were of etiological significance, because they were superficial and the tubes were not involved. The only evident possibility as to cause is the presence of the corpus luteum in the ovary on the side opposite to that of the pregnancy. Assuming that the ovum was impregnated directly on discharge, it could have grown too large to pass through the right interstitial tube while traversing either the uterine, or the abdominal cavity.

This case illustrates very well the misleading lack of severity of symptoms in the early months of an interstitial pregnancy.

I wish to acknowledge my gratitude to Dr. G. Brown Miller of the Columbia Hospital Staff for his permission to report this case.

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THE SYNDROMES OF GASTRO-ILEOSTOMY AND GASTRO-ILEAC ULCER

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ANASTOMOSIS between the stomach and small intestine has become the procedure of choice in the hands of many surgeons for the treatment of lesions of the stomach and duodenum. The operation may be carried out with associated gastric resection or by simple anastomosis. There have been many varieties of such anastomosis, especially as to the type of loop, whether long or short, isoperistaltic or antiperistaltic, and as to the length and site of the stoma. However, in the operation which is ordinarily called *gastro-enterostomy* it is intended that the jejunum should always be used for the anastomosis and the operation should therefore more accurately be termed *gastrojejunostomy*.

It is our intention to present a series of cases in which gastro-ileostomy was performed instead of gastrojejunostomy and to point out some of the results following this distinctly abnormal anastomosis by which the jejunum and parts of the ileum are short-circuited. That a loop of ileum instead of jejunum was used in these cases in forming the anastomosis seems to indicate clearly easily avoided surgical error. In 2 of the 7 cases of gastro-ileostomy to be reported, there was definite secondary ulceration of the ileum with the formation of an ulcer. In one case there was thickening of the gastro-ileac stoma suggestive of gastro-ileitis. In a search of the literature we found reports of only 2 cases of gastro-ileostomy. Carroll, in 1915, reported having operated on a negress aged 26 years on whom a gastro-ileostomy had been previously performed; the anastomosis was made in the ileum, 50 to 60 centimeters above the ileocecal valve. The second case was reported by Mercur, in 1917, and was that of a woman aged 38 years, the anastomosis was about 16 centimeters in length and was placed between the stomach and ileum. In neither of these cases, in both of which exploration was subsequently carried out and the anastomosis disconnected, was there secondary ulceration in the ileum. The primary operation in both cases had been made because of ulceration with hæmorrhage of the stomach.¹

¹The only case of gastro-ileac ulcer recorded in the literature of which we are aware is that reported by Klein (Klein Eugene. The fundamental principles of the treatment of gastric and duodenal ulcers. Arch. Surg. 1910 xii 730-743). He mentions that Berg found a large indurated gastro-ileal ulcer in a patient in whom a surgeon had by mistake performed a gastro-ileostomy.

Our series consists of 7 cases of gastro-ileostomy, in 1 of which jejuno-ileostomy also was performed, and 2 cases of gastrojejunostomy and jejuno-ileostomy. These operations had all been performed prior to the registration of the patients at The Mayo Clinic, and in all except 1 case, operation was subsequently performed at the clinic. We have, therefore, in all except 1 case, surgical confirmation of the presence of gastro-ileostomy or jejuno-ileostomy and in the unexplored case there was little doubt, from clinical and roentgenologic examinations, of the presence of the aberrant anastomosis.

REPORT OF CASES

CASE 1. A woman, aged 35 years, a Russian Hebrew, first came to The Mayo Clinic because of abdominal pain. Cholecystectomy for cholecystitis with stones had been performed 1 year before admission, and 6 months afterward gastro-enterostomy for a "scar in the duodenum close to the pylorus" had been performed. The symptoms preceding gastro-enterostomy had lasted for 3 months and consisted chiefly of severe upper abdominal pain which came on irregularly. Nausea and vomiting followed the eating of all types of food. Other symptoms were epigastric fullness, regurgitation of acid, periodic epigastric pain, and slight lower abdominal pain with diarrhoea consisting of four or five loose stools daily at intervals, and persisting for 2 or 3 days. The patient had lost from 20 to 30 pounds in weight.

Examination disclosed mild secondary anemia. The fractional gastric analysis showed free hydrochloric acid 30 and total acidity 50, 140 cubic centimeters was recovered. Roentgenograms revealed a small gastrojejunal ulcer opposite the stoma, deformed duodenal cap, and patent pylorus. A diagnosis of gastrojejunal ulcer was made and surgical treatment was advised. The patient went home for 6 weeks before returning for operation and during this time the symptoms persisted with perhaps more pain above and to the right of the umbilicus.

At operation an ulcer was found opposite an anastomosis made in the upper part of the ileum. The gastro-ileostomy loop was disconnected, the ulcer was excised, the opening in the ileum was closed and partial gastrectomy of the posterior Polya type was done. The pathologist reported a gastro-ileac ulcer 6 millimeters in diameter. Convalescence was uneventful.

Prior to the gastro-ileostomy the symptoms were not those usually assumed to be diagnostic of ulcer, and apparently active ulcer was not present in the duodenum at the time of the operation. Despite this fact an ulcer developed just below the ileac anastomosis. Through some error the ileum was attached to the stomach on the assumption that gastrojejunostomy was being performed.

limits. The patient was not strong enough to stand any special gastro-enterologic or roentgenographic examinations. Little improvement occurred under vigorous medical treatment, although the thrush responded well. Vomiting continued and fecal material was frequently included in the vomited gastric content. Fecal material was lavaged from the stomach on several occasions. Despite the patient's poor condition, surgical exploration was advised on account of the apparent signs of intestinal obstruction.

On the morning of operation, 1 liter of fecal matter was lavaged from the stomach. At operation gastro-enterostomy was found with anastomosis of the posterior wall of the stomach to the jejunum, and entero-anastomosis between the jejunum and the lower part of the ileum just above the cæcum. The upper part of the jejunum was friable and diffuse inflammation was present. Disconnection of the gastro-enterostomy loop and entero-anastomosis were carried out. The patient died 36 hours later. Necropsy was not obtained.

CASE 5. A woman, aged 44 years, registered at the clinic because of abdominal pains and diarrhoea of several years' duration. She had had symptoms typical of peptic ulcer for 10 years with several gastro-intestinal hæmorrhages during that time. Seventeen months previous to admission to the clinic, the abdomen had been explored, and although ulcer was not found gastro-enterostomy was done. She was free of symptoms for 6 months and then she had recurrence of the epigastric pain, somewhat to the right under the costal margin, which was less severe than that experienced prior to the operation. Food did not completely ease the pain. She had noted loose stools at intervals with undigested food particles in them. Melena had occurred approximately every 4 weeks since operation.

The hæmoglobin was 7.6 grams in each 100 cubic centimeters and the erythrocytes numbered 4,260,000. Total acidity of the gastric content was .48 and free hydrochloric acid was 30, 50 cubic centimeters was recovered. Roentgenograms of the stomach revealed a low gastro-enterostomy which was free with a long reversed loop. The pylorus was not patent.

At operation it was found that gastro-ileostomy had been done, the anastomosis in the ileum was midway between the duodenojejunal angle and the ileocecal valve. The duodenum and intestine appeared normal. The gastro-enterostomy loop was taken down and the anterior half of the pyloric muscle was excised. The posterior wall of the duodenum was inspected but ulcer was not found. There was a slight fissure, irregular in shape and width, which bled easily on touch. This area was cauterized, the edges were sutured, and the operation was completed as gastro-duodenostomy. The pathological report was duodenal tissue with inflammation of the serosa. The patient recovered uneventfully.

CASE 6. A man, aged 31 years, came to the clinic complaining of daily vomiting of bile. He had lost 50 pounds in weight during the preceding year. He had had dyspepsia for 9 years with sour eructations, a sense of weight in the epigastrium, and pain after meals from which he obtained relief with soda. Fourteen months previously he had had severe colic like epigastric pains, especially at night, with nausea, and later he had noticed blood in the stools. At that time a duodenal ulcer was found at operation and gastro-enterostomy was performed. The condition improved following operation but the patient began to vomit bile again in 2 weeks, and this persisted with the development of marked weakness. Exploration again a year later disclosed so many abdominal adhesions that nothing further was done. The bowels became irregular and loose, he vomited fecal material, and gradually became weak and emaciated.

Examination revealed tenderness and spasticity of the epigastrium. Hydrochloric acid was absent in the gastric contents. At operation dense adhesions in the upper part of the abdomen were found. Gastro-enterostomy with the anastomosis in the ileum within 12.5 centimeters of the ileocecal valve was found and was disconnected.

CASE 7. A woman, aged 43 years, a Russian Hebrew, had had abdominal pain for 3 years, followed by vomiting, nervousness, and marked constipation. It was difficult to obtain a satisfactory history. Thirteen months previously she had been operated on elsewhere and the gall bladder and appendix had been removed. Gastro-enterostomy was also performed for "an indurated area below the pylorus with marked stenosis." She had never been well since, complaining chiefly of nervousness, headache, belching of gas with a faecal odor, "needle like" abdominal pains, and diarrhoea. The bowels moved once or twice daily and several times a week she had from four to six loose stools.

Gastric analysis revealed total acidity of .38, and free hydrochloric acid of 2.4, 90 cubic centimeters was recovered. Roentgenograms of the stomach revealed a normal stomach and duodenum, the gastro-enterostomy loop was free and the anastomosis was apparently made low in the ileum. A barium enema did not show a fistula between the colon and the stomach.

A diagnosis of gastro-ileostomy was made and at operation the anastomosis was found to be 6 centimeters from the cæcum. There was no evidence of past or present gastro-duodenal ulceration. The anastomosis was disconnected and the patient recovered uneventfully.

CASE 8. A woman, aged 35 years, a Russian Hebrew, came to the clinic because of burning epigastric pain which had begun when she was aged 18 years. The symptoms were characteristic of peptic ulcer, occurring 1 hour to 1½ hours after meals. After 5 years of distress gastro-enterostomy was performed elsewhere. Four days after the operation profuse diarrhoea developed, consisting of ten to twelve stools daily (sometimes a stool every hour). The diarrhoea continued for 2 years, when the stools were reduced to four or five daily. The burning epigastric pain continued, and was not eased as completely by food and soda. She had lost 22 pounds in weight.

Examination disclosed tenderness in the abdomen above the umbilicus. The total gastric acidity was .22, free hydrochloric acid was absent, and the gastric contents amounted to 32 cubic centimeters. Roentgenograms of the stomach disclosed at first a free gastro-enterostomy, and a deformed duodenal cap. Subsequently the anastomosis was shown to be between the stomach and lower part of the ileum, permitting harum to pass almost immediately into the large bowel.

The patient refused to be operated on and further information concerning her has not been obtained.

CASE 9. A man, aged 32 years, came to the clinic because of "stomach trouble" of 10 years' duration. The symptoms were typical of duodenal ulcer and 1 year after the onset operation was performed. The nature of the operation was not known to the patient but presumably it was gastro-jejunoostomy. Five months afterward the symptoms all recurred and to them were added hæmatemesis and melena. For six years intermittent periods of epigastric distress with ulcer characteristics had occurred. In 1924 a second operation was performed, the nature of which was not known to the patient. This was followed by relief of symptoms for a year and a half following which there was recurrence of pain and vomiting with some relief from alkalis and a bland diet. For several months he had experienced daily gastric distress associated with abdominal distention. A few days prior to admission he noted slight oedema of the feet and ankles and puffiness of the face and eyelids.

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The point occurred unexpectedly 4 years later reported by letter that he was crying and had been ill since the previous time.

At the first operation cholecystitis and a gastric ulcer were found for which evidently cholecystectomy and gastro-ileostomy had been performed. Entero enterostomy was done at a subsequent operation which was performed because of obstruction. The patient remained well for several months when symptoms again suggesting ulcer developed. This time the pain came on lower than the original pain and was referred downward into the iliac fossa. The case presented the usual ulcer characteristics.

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In this case the operative procedure was undertaken because of an ulcer at the pylorus. Instead of gastrojejunostomy gastroileostomy as performed apparently lay in the ileum. The symptoms which developed follow in the operation were characteristic of this type of anastomosis. There was some thickening of the stoma which was similar to that seen occasionally surrounding a gastrojejunostomy stoma performed for peptic ulcer. It is a condition which is perhaps analogous to that of gastrojejunitis (4) in this case a condition suggest *not* gastro-ileitis.

C s 4. A man aged 35 years came to the clinic because of intermittent abdominal distention, pyrosis, and nausea, thus soon after eating which had been present for 5 years. She missed occasionally but had a pain. She had lost 4 pounds in weight. She remained practically milk-free for 2 years during which time she was free of symptoms and gained the lost weight. In this case he admitted gastrostomy as performed 15 days later. Fifteen days later the weight was necessary to perform an anastomosis. Murphy's test account of missing a focal lesion. It depended on the weight and this gradually healed and she remained well for several years. After this time the abdominal symptoms curbed were associated with missing of glossitis. She had lost 9 pounds. Diarrhea had been present for 3 weeks.

The patient was extremely emaciated and debilitated. The blood pressure was low throughout. On the tongue were large, thick, translucent plaques of membrane. There was tenderness and thrush at the pharyngeal area was raw and excoriated. Abdominal examination limited tenderness beneath the scar at the right side. The hemoglobin was 75 per cent. The leukocytes numbered 9000 and the differential count as normal. The blood urea was 4 milligrams in each cubic centimeter and the blood chlorides and carbon dioxide combining power of the plasma were within normal limits.



Fig 1 A small deeply penetrating ulcer of the ileum 6 millimeters in diameter with an attached fibrinous exudate

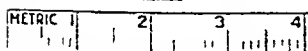


Fig 2 The edge of the ulcer, and chronic inflammatory reaction, proliferating epithelium, and fibrinous exudate

Secondary ulceration was accompanied by the shift of the pain in 1 case to the lower part of the abdomen and in the other radiation of the epigastric pain into the back and both iliac fossæ. These pains had the usual ulcer characteristics. The shift of the pain in gastrojejunal ulceration is usually toward the left and to the level of or below the umbilicus. In gastro-iliac ulceration the pain apparently is shifted or radiated to the lower part of the abdomen, either in the median line, or else to both iliac fossæ.

Vomiting It is of interest that vomiting to some degree occurred in almost every case. In 3 cases it was definitely fecal and in one case gas with a fecal odor was belched. The presence in the stomach of contents from the lower part of the intestine or colon may also be shown by gastric lavage.

DIAGNOSIS

The diagnosis of gastro-ileostomy should be relatively simple from the clinical history. It a gastro-enterostomy is followed almost immediately by intermittent henteric diarrhoea without blood, pus, or mucus in the stools, with rapid loss of weight, possibly the vomiting of fecal material, and absence of much abdominal pain, gastro-ileostomy or an equally faulty gastro-enteric anastomosis has probably been made.

In all but one of the present series of cases gastric acidity was low. This in itself, however, is not a diagnostic feature since gastric acidity is also usually low after gastrojejunostomy.

Roentgenological consideration of gastro-ileostomy may be diagnostic, as in some of the reported cases the anastomosis was so low in the ileum that the opaque meal passed rapidly into the cecum.

Secondary ulceration of the ileum is to be determined exactly as is secondary ulceration of the jejunum.

RESULTS AND COMPLICATIONS

The results of gastro-ileostomy may be divided into three groups (1) mechanical, consisting of diarrhoea, vomiting, and loss of weight, (2) inflam-



Fig 3 Penetration of the ulcer through the muscle layer with marked chronic inflammatory reaction

stomach, duodenum, and jejunum, is susceptible to peptic ulceration. In each case the anastomosis was in the upper portion of the ileum and the pain was referred to the lower part of the abdomen. The pain these patients complained of was not so severe as is usual with gastrojejunal ulcer. It has been suggested that the lower part of the gastro-intestinal tract has a diminished sensitivity to pain impulses. Further evidence for this might be adduced from the fact that in the iliac ulcer coming under our observation the symptom of pain was less severe than that usually experienced with jejunal ulcer. Neither were the gastric acids so high as are ordinarily encountered in secondary jejunal ulceration. In both cases a diagnosis of gastrojejunal ulceration was made by the roentgenologist although in neither case was the clinical picture typical.

There is little clinical or surgical evidence that a duodenal ulcer was present in Case 1 before or after the original gastro-enterostomy, and the development of secondary ulceration in the small bowel is unusual since such secondary ulcers are rare except following gastro-enterostomy for peptic ulcer. In Case 2 the occurrence of ulceration of the ileum was hardly a prominent feature since there was an interval of 4 years between the original operation and the visit to the clinic. During the last of these years constipation was present and there was no loss of weight. This patient had a gastric ulcer, and it is known that secondary jejunal ulceration occurs relatively less frequently after gastro-enterostomy for gastric than for duodenal ulcer. These patients both presented clinical features which therefore should militate against the presence of secondary enteric ulceration.

Figure 1 shows the ileal ulcer in Case 1, a small deeply penetrating ulcer 6 millimeters in diameter with an attached fibrinous exudate overlying it. Microscopic examination (Figs 2 and 3) disclosed a typical chronic penetrating ulcer of the ileum with little evidence of healing. There was considerable scar tissue in the base which had penetrated through the muscular layer and in which the walls of the vessels were markedly thickened. As the surface of the ulcer was approached considerable acute inflammatory reaction was encountered. Roentgenographic evidence of the ileal ulcer is shown in Figure 4.

TREATMENT

The only satisfactory treatment for the unfortunate surgical error of gastro-ileostomy is the surgical disconnection of the anastomosis with re-establishment of the normal continuity of the gastro-intestinal tract. Additional operative meas-



Fig. 4. Roentgenogram in which arrows point to the crater of the ulcerated area in the ileum.

ures may be necessary in the presence of organic disease independent of, or associated with, the anastomosis. Pre-operative treatment is important, since these patients are frequently dehydrated and undernourished as a result of diarrhoea and inadequate nutrition.

The stoma of gastro-enterostomy and entero-anastomosis should always be as high in the small bowel as is consistent with the lesion and which can be performed without undue tension on the intestinal loops. The short circuited loop should always be as short as is reasonably possible.

SUMMARY

The general characteristics of secondary peptic lesions which occasionally occur about a gastro-jejunal stoma can be reduplicated even to certain minute histopathological characteristics by similar lesions which may develop subsequent to the formation of anastomosis between the stomach or the jejunum and the lower part of the ileum.

Clinical evidence is suggestive that the potentiality for the development of peptic lesions arises whenever and wherever any segment of intestinal mucosa is exposed to the eroding action of the gastric chyme.

It would appear that a syndrome fairly characteristic for gastro-ileostomy can be formulated. If, following an operation performed for a gastric lesion, particularly if there is some evidence that a side-tracking operation had been attempted, the

SUMMARY OF CLINICAL DATA

C	A	P r i m a r y	A s t o m o s i s	S e c o n d a r y	E t i o l o g y	S y m p t o m s	A d		R o c k e n d g u e s s	O p e r a t i o n
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	M	D u o d e n u m	G a s t r o i s t o m y u n o c l o s u r e			D i f f i c u l t y i n b o d y i n g f o o d				D u o c o n n e c t i o n
	F	I n t e r s t i t i a l	G a s t r o i s t o m y u n o c l o s u r e			I m m e d i a t e r e s u l t o f f o o d t o l o s t f o u n d i n g m a t e r i a l		8		D u o c o n n e c t i o n
	F	D u o d e n u m (?)	G a s t r o i s t o m y u n o c l o s u r e			D i f f i c u l t y i n b o d y i n g f o o d				D u o c o n n e c t i o n
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matory manifested as gastro ileitis and (3) ulcerative manifested as ulceration of the ileum. These three groups are represented in the cases reported here. It would seem apparent from the case histories that enterostomy with the stomach in the lower part of the ileum associated with the stricture, as ordinarily performed, is considerably like gastro ileostomy and produces the same effects.

In the majority of cases the effects of gastro ileostomy were simply those of mechanical disturbances of gastrointestinal activity which are readily understood. In 2 cases the disturbance in nutrition was so profound that the patient was unable to withstand the operative procedure. In the disconnection of the gastro-ileostomy loop

Case 3 appears to be a good example of secondary inflammation of the ileum or gastro-ileitis similar to gastrojejunitis following gastrojejunostomy (4). The presence of rather high gastric acids (total 7 free hydrochloric 58) the relatively large quantity of gastric contents (100 cubic centimeters) for a stomach on which gastro-enterostomy had been performed, the slight irregularity of the stomach and dilatation of the ileum on roentgenologic examination and the thickening of the stomach at operation all pointed to the presence of gastritis, although this could not be proved definitely in the absence of tissue for microscopic study.

Gastroileal ulceration: The occurrence of the ileal ulcer indicates that the ileum as well as the

TREATMENT OF THE *FORME FRUSTE* TYPE OF PERFORATED PEPTIC ULCER¹

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IN a previous issue of SURGERY, GYNECOLOGY AND OBSTETRICS we (8) described a particular type of ruptured peptic ulcer which distinguishes itself from the classical form in that the postperforative course is relatively brief and tranquil. It was pointed out that, whereas in the textbook type of perforation, the manifestations following rupture are those of a diffuse, progressive inflammation, in the type described the symptoms correspond to a localized, receding peritonitis. It was furthermore stated that in the group under discussion the later in the course of illness the patient is observed, the more effaced and deficient is the clinical picture of peritonitis. In order to emphasize the mild and incomplete character of the perforative peritonitides in this particular group at the time patients generally present themselves for diagnosis, the term "*forme fruste*" was selected. The tranquillity of the postperforative course and the frequent, spontaneous recoveries in the *forme fruste* ruptures were ascribed to cessation of leakage due to spontaneous closure of the opening.

Since the prime purpose of the article was to call attention to the frequent occurrence and means of recognition of *forme fruste* perforations, merely this brief statement was made with reference to treatment. "If recognized within the first 24 hours, the patient with a perforation (*forme fruste*) is, as a rule, operated upon immediately regardless of the severity or mildness of the symptoms. In the event that the patient is not seen until the second day, i.e., between the twenty-fourth and forty-eighth hours after perforation, surgical treatment is practiced unless the symptoms and signs point indubitably to a spontaneous closure and trifling leakage. If there is any question as to the perforation being sealed, operation is insisted upon. After the first 24 hours, it is generally not difficult to decide whether the perforation is closed or not." The suggestion contained in this concise reference to treat without operation, selected *forme fruste* perforations when seen for the first time late in the course of the illness provoked rather sharp adverse criticism. From the nature of the objec-

tions advanced, it was clear that the commentators failed to take into account two important facts which serve to distinguish the *forme fruste* from the classical perforation.

They assume that spontaneous recovery following acute perforation is rare or unique and that unless surgically closed, a ruptured ulcer almost invariably leads to a fatal outcome. While this assumption is probably more or less true of the textbook type of rupture with unrestricted leakage, it does not apply to the *forme fruste* perforation where the escape of gastric content is usually merely trifling. In these mild cases the spontaneous closure of the hole promptly limits the intensity and extent of the peritonitis, and recovery frequently follows without surgical intervention. That spontaneous recuperation from acute perforation is by no means uncommon is attested to by the fact that in a recent survey at the Cook County Hospital 40 such instances were collected within a period of 18 months. The details of the individual cases and references to similar cases reported from other sources are contained in a previous communication (7). Further papers dealing with small series of cases of spontaneous recovery not contained in the article mentioned, have been published by Struthers, Van Amstel, Bruett, and Bager. Many single reports of recovery without operation, some of which were not recognized as perforations by their authors, can be added. Scrutiny of the facts connected with the individual cases of spontaneous recovery indicates that the perforation in a very large percentage is of the *forme fruste* type. We feel justified, therefore, in concluding that recovery from acute rupture of this mild type is a common occurrence.

A second fact which our critics fail to appreciate is that the *forme fruste* cases present in the postperforative stage a clinical picture which differs greatly from that of the classical rupture. A great many of the milder perforations, unless seen quite early, pass unrecognized and are handled medically under a mistaken diagnosis. Patients with *forme fruste* perforations are frequently erroneously considered to be suffering

¹ From the Department of Medicine, University of Illinois College of Medicine, and the Divisions of Medicine and Surgery of the Cook County Hospital, Chicago, Ill.

patient begins to lose weight to have persistent diarrhoea, faecal vomiting and faecal belching and to lose weight rapidly despite normal appetite and normal ingestion of food the suspicion should arise that an anastomosis has been made erroneously between the stomach and the ileum or colon. Similar symptoms may be produced by anastomosis between the jejunum and the ileum or colon.

Following a period during which such symptoms have developed pain is superimposed and if this pain is situated lower than the original pain and arises from 30 minutes to several hours after meals if it be referred downward or through to the back and is to any degree amenable to the ingestion of food or to the taking of an alkali the presence of a gastro-iliac ulcer may well be suspected.

The surgical formation of gastro-ileostomy in itself may not be productive of definite symptoms because in certain cases the pylorus remains

patent and maintains its physiological function so that most of the food reaches the caecum and the small bowel in the normal fashion thus preventing emaciation, dehydration and constipation. The more the gastric contents leave the stomach through the stoma the more definite the syndrome of gastro-ileostomy will become.

BIBLIOGRAPHY

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¹ From the Department of Medicine, University of Illinois College of Medicine and the Division of Medicine and Surgery of the Cook County General Hospital, May 1, 1931.



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Fig 2 Case 2 With the patient lying on the left side the free air in Figure 1 shifts to a position between the lower right ribs and the lateral border of the liver. Intra-peritoneal air, *a*, air in the lung at the cardiohepatic angle, *b*, intragastric gas bubble, *c*, gas in ascending colon, *d*.



Fig 3 Case 4 Roentgenogram taken 2½ days after perforation. The thin zone of intraperitoneal air (indicated by arrows) was the only clinical evidence at this time of a perforated viscus.

we anticipate misapplication of the knowledge that spontaneous recovery not infrequently occurs. With the more general use of the X-ray and more frequent resort to surgery in cases with abdominal pain of obscure origin, an increasing number of practitioners will note the tendency on the part of nature to seal or plug the perforation. We are fearful lest some physicians, after observing a case or two of recovery where operation for one reason or another has been omitted, will conclude that all acute ruptures which are not attended by fulminant symptoms can be treated medically with safety. As a matter of fact one can detect a tendency in this direction even at the present time. The literature contains reports of cases of "covered" perforations (Bondi, Falta, Wickbom) which we feel were surgical cases but which advertently were handled without operation.

It is a difficult matter to formulate any absolute rules with regard to the treatment of *forme fruste* perforations. There are cases in which the hole is plugged or covered almost immediately after perforation whereas in other cases spontaneous closure does not occur until a longer interval of time has elapsed and a moderate amount of leakage has ensued. Best results are obtained by basing judgment upon the clinical facts in each individual case rather than adhering rigidly to any proffered rule. The more experience the attending surgeon acquires the less reliance does

he place upon a preconceived scheme. Generally speaking, the earlier the patient is seen after the moment of perforation the more difficult is it to decide as to the type of rupture present and the more desirable is prompt surgical intervention. The later in the postoperative course the patient is seen, the easier it is to judge the type of perforation present but the less satisfactory are the results accomplished by surgery.

For didactic purposes we have adopted the following arbitrary plan. Patients seen within the first few hours after perforation are almost invariably operated upon since at this early stage it is difficult or impossible to determine whether or not the rupture is firmly closed and leakage has ceased. The operative mortality is not over 4 or 5 per cent in these cases. Between the twelfth and twenty-fourth hours we generally operate, unless the evidence is quite clear that the peritonitis is closely limited and is in the stage of recession. Unless one has had considerable experience with the acute surgical abdomen, it is probably safer to explore all cases seen the first day following rupture. After the first 24 hours, sufficient time has elapsed in the average case to permit the surgeon to ascertain the extent and severity of the peritonitis, the state of the




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perforation whether closed or open and the general course of the illness whether retrogressive or progressive. It can be determined with a reasonable degree of certainty that the hole is occluded that the peritonitis is benign and that the patient will in the end recover. We are inclined to mit operate enterotomy particularly since peritonitis is mortal at this time. After the second day following perforation the hole should be little if any difficulty in arriving at a decision. In a true sense the first perforation is the first time on the third day of illness the peritoneal inflammation has almost completely subsided the general condition of the patient excellent and operation is therefore not required. It would only set up more peritonitis and the hole when opened might prove to be impossible to be used on the ground of the friability of the tissue. After the third day a free fistula is formed in the hole surgically effectively closed and peritoneal closure might be less secure.

We do not hesitate at this time into any lengthy discussion regarding the ultimate fate of perforated ulcers here immediate esophageal gastroenterotomy is the best treatment. The former it appears that the hole in

the presence of a perforation as derived from peritonitis. Any measure which serves no immediate purpose and which adds to the length of the operation or enhances the risk of the patient is not a perfect one. When and if the patient survives the peritonitis the ulcer can be dealt with at a time when the operation is not nearly as great.

The emergency is concluded with non-operative treatment of the first perforation. The first and most serious reopening of the closed aperture and the second intra-abdominal abscess formation. With regard to reoperation our experience has been that secondary leakage seldom occurs. Although we have been constantly on the alert for it we have failed to observe any case in which reopening of the hole developed during the course of observation. Even here a free fistula perforation had not been recognized and a patient had been given fluids including milk by mouth the feared leakage of the seal of the fistula followed. Although the hazard of the practice is still present the benefit is not negligible nevertheless the well-practiced surgeon is able to prevent further leakage. If the fluid is not entering the stomach the stomach is not a

siderable amount of fluid, an Ewald tube is introduced and the gastric contents are siphoned off by gravity. The patient is then instructed to lie on his left side. In this position any fluid present gravitates to the fundus and the gastric air rises to the pylorus where more than 90 per cent of the perforations occur. Should some of this air leak out, the X-ray will discover it and thus furnish an immediate operative indication. Nothing is given by mouth for 3 days or more, fluids being given rectally and by hypodermoclysis. Modified Sippy is then used.

We have been confronted with very few perigastric or other intra-abdominal abscesses following unoperated upon *forme fruste* perforations. It appears to us that the incidence of persistent localized suppuration is no less in the operated upon than in the unoperated upon *forme fruste* cases. The peritoneum it seems has little difficulty disposing of a limited amount of gastroduodenal leakage, particularly when the hole is a small one and only liquid material escapes. In all but the exceptional case the patient becomes afebrile within a few days following a *forme fruste* perforation. Persistence of fever for more than 3 or 4 days is looked upon as evidence of intra-abdominal suppuration and demands close attention. Spontaneous absorption usually occurs. Sticking pains felt upon stretching or sudden change of position are complained of not infrequently for several weeks after perforation. It should be pointed out that the danger of intraperitoneal abscess formation and consequent secondary spread is very great in cases which are not strictly of the *forme fruste* type. It is, therefore, hazardous to delay surgery unless the evidence for a mild perforation is quite clear.

The appended case reports selected from a rather large number are representative of the group of perforations under discussion and illustrate the following points: (1) At the time a patient with a *forme fruste* perforation generally reaches the hospital the classical picture of a ruptured ulcer (with board-like rigidity, etc.) is lacking. (2) Unless the examiner is cognizant of the mildness of the postperforative manifestations in the *forme fruste* type, the presence of an actual perforation is generally overlooked. (3) A detailed, minute-by-minute history of the onset together with a knowledge of the course of the illness usually leads to a correct diagnosis even in the absence of the accepted physical findings of perforated ulcer. (4) When the patient is seen for the first time late in the course of illness, it is relatively easy in the average case to decide whether or not surgery is advisable.

CASE 1 *Forme fruste* perforation recognized 7½ hours after onset. Operation. Recovery.

R. G., a white man of 50 years, entered the Cook County Hospital on May 19, 1930, at 5 p. m. on account of severe, upper abdominal pain. The history states that the patient was perfectly well until 4 hours preceding admission when while walking rather hurriedly he was seized with severe epigastric pain which caused him to stop immediately. The onset of pain was followed by a profuse sweat and the fear that he would die before arriving home. With difficulty he succeeded in reaching his destination which required a half hour's travel on the street car. He called his physician who diagnosed coronary disease, administered a hypodermic, and advised hospitalization.

Upon hospital entrance there was tenderness and rigidity in the right side of the abdomen and in the epigastrium. The rectal temperature was 99.2 degrees F, the pulse rate 92, and the respiratory rate 22. At the time of entrance the patient was quite comfortable except for soreness in the upper abdomen. The diagnosis of acute cholecystitis was made by the examining surgeon.

We saw the patient at 8:30 p. m., which was 7½ hours after onset. By inquiring into details the assertion was elicited that 4 weeks before entrance the patient began to notice epigastric, gnawing pain which led him to eat at least five times a day. He said he experienced heartburn only once during these 4 weeks. A week prior to admission tarry stools were observed. The day of onset of his acute symptoms he noted nothing unusual until 1 p. m. when he was suddenly seized with such severe pain that he "doubled over." The pain spread throughout the upper abdomen and radiated to the back and to the right shoulder. It required all his reserve strength and courage to mount the street car, tolerate the agony experienced during the ride, and to walk a block after alighting from the car. Without drooping he threw himself on the bed and ordered his wife to summon a physician immediately. Following the hypodermic the pain moderated to such a degree that were it not for the insistence of the family doctor who predicted subsequent attacks the patient would not have consented to hospitalization.

The diagnosis of *forme fruste* perforation was made and operation recommended. The fluoroscopic examination undertaken en route to the operating room failed to disclose the presence of free air. Before laparotomy the stomach content was siphoned off and about 200 cubic centimeters of a brownish material with an alkaline reaction was obtained. When the peritoneum was opened there was seen a moderate amount of fibrin in the upper abdomen mainly on the right side. The pyloric region and duodenum were covered by the liver. By gently raising the liver it could be seen that its under surface was adherent to the anterior duodenal wall. When the loose adhesions were separated, a 4 millimeter perforation located on the anterior wall of the duodenum was disclosed. There was slight induration spreading beyond the margins of the rupture. The hole was sutured and covered by an omental flap. Recovery was uneventful.

CASE 2 *Forme fruste* perforation diagnosed 13½ hours after onset. Operation. Recovery.

F. W., a white man of 22 years, entered the hospital May 2, 1930, at 2:30 a. m. on account of acute abdominal symptoms. The suspicion of a surgical abdomen was entertained by the admitting physician but the patient did not appear "sick enough" to warrant a positive diagnosis. The history obtained by the house physician reads as follows: "For the past week the patient has been troubled by constiveness which occasioned resort to various cathartic pills without benefit. On May 1, 1930, at 10:30 p. m., following ingestion of part of his supper, the patient felt

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ately vomited. The pain continued intense until about the following morning (April 26) when it became tolerable. At 4 a.m. the patient fell asleep and awoke at 9 a.m. with abdominal "soreness." He was given a fluid mixture containing peppermint which he retained. He arose but returned to bed after half an hour as movement caused pain. At noon he went to the table and drank a bowl of soup. He returned to bed and arose again at 5 p.m. when he had a second bowl of soup and two glasses of water. That evening, April 26, which was the day following rupture he remained up and about conversing freely with friends. He retired at the usual time, slept well, arose the following morning (April 27) and ate a fair helping of gruel. Later in the morning, because he was still weak and some degree of soreness persisted, he decided to go to the hospital.

Upon admission which was 38 hours after the onset of acute pain his temperature was 101 degrees F, the pulse rate 100, and the respiratory rate 24. The patient appeared quite comfortable and did not give the impression of being at all ill. As a matter of fact when we first saw him 2 hours later he was partaking of and seemingly enjoying some soup and milk which were inadvertently served him. The physical observations consisted of slight tenderness and rigidity on the right side with some diminution in peristaltic activity. The respirations were abdominal in type and unrestricted. No shifting tympany obliterating the normal liver dullness could be demonstrated. Fluoroscopic examination disclosed the presence of free air in the abdominal cavity.

It was apparent that the patient had suffered from a ruptured ulcer. However, because of the mildness of the symptoms and the limitation of the peritonitis, it was believed that the perforation had closed spontaneously. The fact that the patient had ingested fluid without any ill effect led to the assumption that the closure was a secure one. The patient was instructed to remain on his left side, the gastric contents were siphoned off and proctoclysis was instituted. The following day, April 28, 1931, the patient felt and looked well and was entirely free from pain. There was very slight tenderness in the right upper quadrant elicited only upon deep pressure. The highest temperature recorded that day was 100.4 degrees F, the maximum pulse rate was 76. The general condition of the patient appeared so satisfactory it was felt that a radiographic examination could be undertaken with impunity. The X-ray film (Fig. 3) taken April 28, showed a slight diminution in the quantity of intraperitoneal air as compared with the amount noted fluoroscopically on the previous day. Daily radiograms showed a gradual absorption of the escaped air (Fig. 4) until May 2, 1931, when all evidence of a pneumoperitoneum was seen to have disappeared (Fig. 5).

On April 29 (3½ days following perforation) no signs of illness were detected. The temperature, pulse, and respiratory rates became and remained normal. On April 30, fluids by mouth were started. On May 4, the patient was up and about and on May 6, was discharged feeling quite well. He returned for a barium meal study on May 15, 1931, when a duodenal deformity significant of ulcer was demonstrated. The excursion of the diaphragm was not restricted.

CASE 5 *Forme fruste* perforation first observed 3½ days after onset. No operation. Recovery.

A.O., a white man, aged 39 years, was admitted to the Cook County Hospital October 13, 1930, complaining of previous periodic attacks of abdominal pain and vomiting. The temperature was 99 degrees F, the pulse rate was 100, and the respirations 24. Physical examination showed evidences of *tuberculous dorsalis* (including Argyll Robertson

pupils), a scaphoid abdomen, and tenderness on the right side, especially in the upper half. There were also physical signs of an active tuberculosis in both lungs. To account for the abdominal symptoms the diagnosis of gastric crisis was made and accordingly anti-tuberculous treatment was prescribed. An assertion made by the patient to the effect that soda had afforded some relief during previous attacks served to cast doubt upon the accuracy of the diagnosis mentioned and to occasion our interviewing the patient on October 14, 1930, 3 days after onset.

By careful inquiry and cross-questioning we obtained an account of periodic attacks of epigastric pain of the ulcer type associated with vomiting. The symptoms would cease spontaneously, after which the patient would feel well until the succeeding attack appeared. The last recrudescence began a month or so prior to entrance, on which account a physician who was consulted prescribed a milk and cracker diet and powders after meals, with some relief.

On October 11, 1930, 2 days before admission the patient was awakened from sleep at 3 a.m., by a most agonizing pain located in the epigastrium and right hypochondrium. He writhed about yelling for aid but was unable to arouse his neighbors. Finally he assumed a fixed supine position with his right thigh flexed upon his abdomen. Motion as well as palpation elicited sharp pain referred to the right side. By 7 o'clock a.m. the patient had sufficiently improved to leave his bed and to summon a neighbor who was requested to fetch a quart of milk. The patient drank the entire amount, immediately following which vomiting ensued and the pain recurred. The pain continued severe for 3 hours, after which it abated.

The patient felt fairly well after 10 o'clock a.m. except for abdominal soreness. He stated that he would have gone to work at noon were it not for his inability to straighten up without resultant pain in the upper abdomen. He was physically able, however, to go to the restaurant for milk and crackers. The following day, October 12, he was still incapable of walking erect. On October 13, the patient went to work, but finding himself physically unfit he decided to come to the hospital to convalesce.

We saw the patient for the first time on October 14, which was 3 days after the onset of acute pain. The last note recorded by the nurse previous to our examination read "Temperature, 98 degrees F, pulse, 88, respiratory rate, 20. Slept well all night. Offers no complaint. Cheerful." We were able to elicit moderate tenderness in the right hypochondrium and slight tenderness over the right iliac fossa. The X-ray failed to disclose the presence of a pneumoperitoneum. An infiltration was noted in both upper pulmonary lung fields. The Wassermann test on the blood had been returned 3 plus, and on the spinal fluid 4 plus. We considered operation for the purpose of closing the perforation unnecessary at this time and on account of the tuberculosis and syphilis we deemed surgery inadvisable. The patient's abdominal symptoms subsided on conservative management. A subsequent X-ray examination with barium showed a duodenal deformity characteristic of ulcer. The patient was subsequently transferred to the tuberculosis ward entirely free from abdominal complaints.

SUMMARY AND CONCLUSIONS

In treatises on perforated ulcer, it is generally stated that spontaneous closure of perforation seldom occurs. On the basis of this assumption the logical conclusion with regard to treatment is to operate upon practically every ruptured

TRANSPLANTATION OF TENDONS WITH STABILIZATION OF PARALYTIC TALIPES

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POLIOMYELITIS has probably been with us since earliest times as suggested by incidences described in some of the carvings of Egypt's pyramids, in biblical history, and by the deformities occurring in some of the famous characters of our more recent history. However, it was not until 1793 that the first description of the disease appeared in medical literature. In 1840, Heine presented the first systematic study of the condition and since that time we have been confronted by this serious epidemiological and therapeutic problem. It is not the intention in this short paper to go into the various phases of prevention of the disease, early treatment of active cases, or treatment of the various types of deformities occurring with inefficient care but to deal with a rather interesting portion of the surgical management of the residual paralytic involvement of the feet.

In a brief way, the nature of the disease is that of an acute onset of some fever accompanied by disturbances of the gastro-intestinal, respiratory, and excretory systems, sweating, meningeal irritation, hyperæsthesia and pain, with the development of a flaccid type of paralysis of an irregular distribution. This paralysis may involve practically the entire body or any portion of it. The hyperæsthesia of the skin surfaces and along the nerve roots, etc., together with tenderness to pressure on the muscles on manipulation of the extremities may be mild or so severe as to cause excruciating pain upon the least disturbance. As the symptoms subside, the pain and hyperæsthesia diminish, and the paralysis begins to clear up in an irregular manner. When the tenderness has disappeared, physiotherapy in the form of heat, gentle massage, and active exercises under proper supervision, aids temporarily paralyzed muscles to regain all or a portion of their strength up to a certain point. The training of active muscles increases the power in those which have been left weakened and educates some of the more powerful ones to take over, to some extent, the physiological function of those permanently paralyzed. Carefully guarding extremities from the development of deformities by the judicious use of splints and braces accompanied by muscle training over a period of a year and, preferably, 2 years, assures one that he has obtained the maximum possible

recovery. This is spoken of as the residual or stationary stage, and active measures designed to rid older children and adults of their appliances are next in order. As the purpose of this paper is to deal entirely with paralysis involving the feet, all procedures referred to will be governed by the facts that they are weight bearing members, and, in order to function efficiently, stability must be the prime consideration. Useful motion is very desirable but must take second place to weight bearing stability.

Muscular imbalance in a weight bearing extremity combined with the forces of gravity and static influences leads to the development of deformities, the degree of which is in direct proportion to the extent to which the conditions already enumerated exist. Completely paralyzed or flail extremities are deformed by gravity and static influences entirely. Untreated or improperly treated cases of infantile paralysis are almost without exception complicated by the development of more or less severe deformities interfering with the recovery and function of what muscles remain physiologically active. One should not relegate the case to the "residual paralysis" group until he has instituted physiotherapy and protective measures for a period following the correction of existing deformities. Stretching of some muscles by virtue of the malposition of the extremity frequently leads to a temporary paralysis of a fatigue type and, following correction, a surprising amount of recovery of muscular power occurs. The importance of proper protection in splints and braces as a means of the prevention of deformities and of assisting in the recovery of muscle power cannot be too strongly urged.

Inversion or varus, eversion or valgus, equinus, calcaneus, and combinations of these positions are the common types of deformities seen. Paralytic talipes valgus and talipes calcaneus are probably the most frequent deformities found in the residual stage due to the fact that the anterior tibial muscle and the calf muscles are the ones most frequently involved and least frequent in incidence of recovery. Following closely upon these deformities are those of varus due to loss of power in the peroneal group. A cavus or hollow foot is frequently found when power is retained

in the peroneal and posterior tibial muscles in absence of power in the calf muscle. As the sequelæ of this muscular and static imbalance various bones in the feet become abnormally prominent and callosities develop upon these prominences due to the pressure of shoes or braces when weight bearing is undertaken. As has been mentioned by various writers many people walk better with artificial limbs as they are not sufferers from the pain of heavy callosities developed upon lateral deformities. There is no reason why paralytic feet cannot be made as stable from a functional standpoint as are artificial feet and still retain more flexibility.

About 1882 Nicoladoni reported the transplantation of the peroneal tendons for the relief of calf muscle paralysis and sounded the opening note for the modern conception of tendon transplantation. The idea was not a new one but his report gave new life to an interesting phase of the surgery of paralytic deformities. Drobniak published an article in 1896 dealing with the transplantation of tendons to new locations usually transplanting them into the peroneum. A wave of enthusiasm developed and many surgeons attempted operations of a similar type with more or less success. Among the many surgeons helping to popularize this type of operation we find Lange, Vulpius, Mueller, Jones and others. Nicoladoni's method which was one of tendon to tendon anastomosis was taken up and perfected by its ardent supporters Vulpius and Codivilla while Drobniak's method of periosteal fixation was perfected by Lange and the idea used in other methods as described by Wolff, Mueller and others. All of these methods refer primarily to the fixation of the transplanted tendon whereas Biesalski and Mayer viewing the problem from a different aspect conceived of the necessity for more careful preservation of the gliding mechanism of the tendon to be transplanted. They passed the healthy tendons through the sheaths of the paralyzed ones utilizing the gliding mechanism of paratenon and mesotenon present to improve the functional results.

The earlier methods based purely on mechanical lines as little if any attention was given to the physiological factors present could not survive. With more study and the mistakes in judgment leading the way modern methods based on physiological and biological principles were developed. Biesalski and Mayer should probably be credited with opening up this new aspect.

Careful studies on the histological structures of the tendon and its gliding mechanism such as those mentioned above and those made by Lovell

and Tanner Bernstein and others have changed the entire conception of the tendon transplantation problem. Tendon nutrition, nature of gliding action, the preservation of the gliding mechanism with the prevention of adhesions between transplanted tendons and surrounding structures have been carefully studied. The evaluation of power in muscles proposed for transplantation and their mechanical efficiency, the effects of the strain of weight bearing and the prospects of obtaining satisfactory stability were problems requiring careful consideration.

Several principles to be followed in the choice of muscles suitable for transplantation have been laid down. It is felt that one should briefly enumerate these principles. First a muscle should have a similar or at least a related action to the one to be replaced and must be treated with its tendon and gliding mechanism etc. as a unit and utilized as such. The method of splitting of tendons and the insertion of the parts into different points has proved unsatisfactory as the muscle and tendon form one unit acting as a whole and portions of the unit cannot be expected to produce antagonistic action by giving them two separate insertions. An antagonistic muscle can be used as a replacement for a paralyzed opponent but long periods of training are necessary to get properly conditioned nerve paths to ensure smooth efficient action.

Second the strength of the muscle to be transplanted must be nearly that of the one which is to be replaced. Third the line of pull from the muscle origin to tendon insertion should be as straight as possible. Maximum efficiency cannot be expected if there is an angulation in the line of pull of the muscle. In the fourth principle we have one of the greatest problems namely the proper tension to be placed on the muscle when the tendon is fixed at the new point of insertion. If the tension is too great fatigue occurs followed by atrophy of the muscle fibers. If not great enough the muscle is inefficient because part of its range of contraction is utilized in taking up the slack in its tendon. Fifth careful attention must be paid to the preservation of the gliding mechanism of the tendon as a means of preventing the formation of adhesions and of supplying nourishment to the transplanted tendon. Anatomico-physiological studies have been made by Biesalski and Mayer, Lovell and Tanner Bernstein and others and these have previously been referred to. As a result of the efforts of these authors the physiological methods of tendon transplantation have been developed. Many operations have been described based primarily upon the preservation of the peritenon and

mesotenon, and the reconstruction of the tendon sheaths. In transplantation mentioned by Lange and others, the tendon has been isolated from its sheath and passed through the subcutaneous tissues. Poor results have been obtained due to the early formation of adhesions. In many of the transplantations about to be reported here, this method has been used in conjunction with subtalar arthrodeses, and the results obtained have been satisfactory.

Bieschke and Mayer describe the transplantation of tendons through the sheaths of the paralyzed muscles with much better results. This method has not been used because with arthrodesis of the tarsus the points chosen for the new insertion of the tendons have not coincided with any available sheaths.

Transplantation of the tendon plus its sheath as a unit as mentioned by Bernstein has not been tried in any of these cases. Sixth, all deformities must be corrected before transplantation is undertaken. Weaker by virtue of mechanical embarrassment due to its new position the transplanted muscle cannot be expected to correct deformities which have probably been present for months or years. Seventh, anchoring the transplanted tendon furnishes ample opportunity for the exercise of ingenuity on the part of the operator. The many methods of tendon transplantation described have all laid emphasis on the insertion of the tendon until the advent of the more recent physiological aspects. To attempt to describe these methods is unnecessary as they are so ably described by their supporters. The subperiosteal fixation of the transplanted tendon has received greatest support, and, in the cases to be reported here, all transplanted tendons have been fixed subperiosteally as mentioned by Wolff or transosseously as mentioned by Mueller.

Tendon-to-tendon anastomosis as described by Nicodemi and Vulpius has been used very satisfactorily in the upper extremity but is looked upon with disfavor in the lower extremities, with one exception. The exception referred to is the method described by Royle for transplanting the posterior tibial or peroneal tendons into the tendo achillis to add to the strength of the calf muscles. The transplanted tendon is stripped of its gliding mechanism for a short distance, split longitudinally, and the two halves laced back and forth through the Achilles tendon so as to interlock the one through the other. It is almost unnecessary to use sutures to make the transplanted tendon secure.

In many cases, the operator, in his enthusiasm, has lost sight of the indications mentioned which govern transplantation and, as a consequence,

unsatisfactory results have been the outcome. Steindler, in 1919, reported a series of 48 cases of transplantation of tendons in the feet with satisfactory results in 75 per cent of cases. This report was very encouraging compared to those published by other authors. By a satisfactory result is meant stability on weight bearing, permanent prevention of lateral deformity, and more or less active function of the transplanted tendon in the line of action of the paralyzed tendon.

In spite of good results reported by a few surgeons, tendon transplantation in itself was proving to be a disappointment in that instead of being a solution for a difficult problem in weight bearing stability it was being represented by poor or bad results. It was little wonder that the question of the practicability of tendon transplantation was raised, and in 1922 the American Orthopedic Association appointed a committee headed by Cook and Stern to study and report on the problem of stabilization of the feet. Most of the feet examined by the commission had been subjected to operation upon the soft parts. Tenodeses, tenotomies, or tendon transplantations had been done, but eventually it had been necessary to perform some operation upon the bones in order to obtain satisfactory stability. It was the opinion that transplantation of tendons should be used only in connection with stabilizing operations upon the bones. The important point brought out was that lateral deformities of the foot must be corrected or prevented permanently in order to have maximum function and freedom from pain. The lateral deformities referred to are inversion or eversion ones and are far more disabling and difficult to treat than those of calcaneus or equinus. If the leg is completely paralyzed or flail, almost any type of support will be sufficient to prevent the occurrence of deformity, but, if any of the invertor or evertor muscles, namely tibialis anterior and posterior, or peroneus longus and brevis are present, it is almost impossible to prevent varus or valgus deformities of the foot. Braces of Hessing and caliper types have been tried, but in spite of these the feet roll into inversion or eversion and painful callosities develop over prominent bony points due to friction on pressure of the braces. The only means of successfully combating this detouring tendency is operative fixation of the foot in the subtalar articulations accompanied where possible by the transplantation of the good muscles to positions of more useful function. As has been mentioned before, stability upon weight bearing is of prime importance, and the conviction that this stability can be ensured permanently only by bony fixation is becoming more firmly implanted every

in the peroneal and posterior tibial muscles in absence of power in the calf muscle. As the sequelæ of this muscular and static imbalance various bones in the feet become abnormally prominent and callosities develop upon these prominences due to the pressure of shoes or braces when weight bearing is undertaken. As has been mentioned by various writers many people walk better with artificial limbs as they are not sufferers from the pain of heavy callosities developed upon lateral deformities. There is no reason why paralytic feet cannot be made as stable from a functional standpoint as are artificial feet and still retain more flexibility.

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the peroneals act with the anterior tibial in the absence of calf muscle power, a calcaneus deformity results. The peroneals alone or with the calf muscles produce valgus deformities. The calf muscles alone or with invertors or evertors produce equinus positions. The posterior tibial alone or with the peroneals in absence of the anterior tibial and calf muscles produces a cavus or hollow foot with a complicating calcaneus deformity. It would be possible to refer to many other variations in the four basic positions of deformity produced by different groupings of the muscles mentioned, but it is not necessary to consume more time for this. The question of which muscle is to be transplanted with the subtalar arthrodesis has been decided before operation.

The technique followed does not vary to any extent from that of Lange and others in which the tendon is passed through a tunnel in the subcutaneous tissue to be fastened to the bone in the forefoot or to the tendo achillis in the posterior foot. The tendon to be transplanted is divided as far distally as possible and a figure-of-eight chromic catgut suture is placed through the distal end. A space is tunneled through the subcutaneous tissue from the proposed point of insertion to well up on the leg so as to be sure that there will not be any angulation in the course of the tendon from muscle belly to insertion.

In the case of transference to the front of the foot, a tunnel large enough to allow the passage of the tendon is bored through the middle cuneiform to the sole of the foot, as suggested in the transosseous method described by Mueller. Next, the sheath of the tendon to be transplanted is opened and the tendon is removed with as much of the paratenon and mesotenon as possible and immediately drawn carefully through the subcutaneous tunnel to the dorsum of the foot. All tunnels for the passage of tendon have been constructed previous to opening the tendon sheath so that the delicate paratendinous structures will not be exposed to drying by the air. The writer tries to pass the tendon under the transverse ligament on the dorsum of the ankle and foot. Failing to do this, although the function is not impaired, the transplanted tendon stands out like a bowstring when its muscle contracts.

The catgut suture previously placed in the distal end of the tendon is threaded through a long straight needle which is passed through the tunnel in the middle cuneiform and through the sole of the foot drawing the tendon after it down as far as the plantar fascia. A one-half inch incision is made in the sole of the foot so that the chromic catgut may be tied, thus fastening the trans-

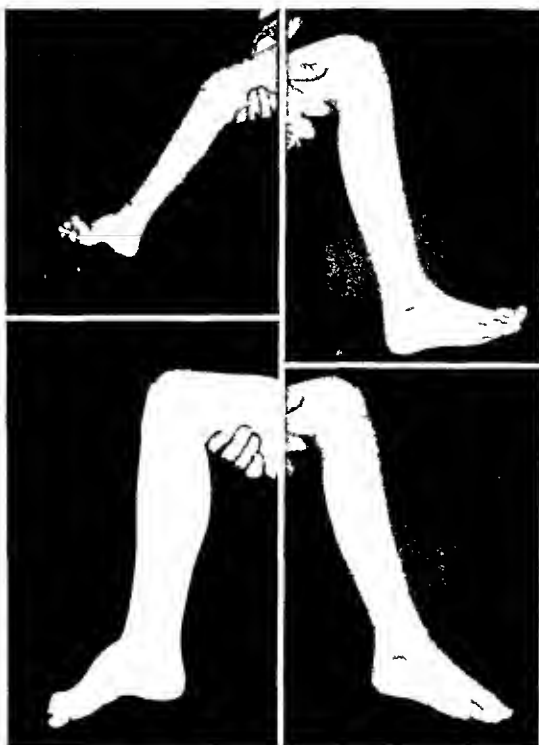


Fig 1 Case 1 A N, No 203 Four views of the right foot are shown. Variations in photographic technique account for the positions used and variation in intensity of the pictures. The upper two views show the active dorsiflexion of the foot before and after subtalar arthrodesis and transplantation of the insertion of the tibialis anterior tendon from the medial side of the foot to the region of the middle cuneiform. The lower views show the active plantarflexion before and after operation. Photographs are not available showing the correction of lateral deformity and the stable position of the foot on weight bearing. The scar from the arthrodesis shows the delayed healing so often found before the technique used in closing the wound was changed as mentioned above.

planted tendon to the plantar fascia. It is important, however, that the degree of tension upon this tendon is sufficient to keep it taut before it is tied. It is very difficult to decide upon how much tension is necessary, but with experience one learns of the happy medium between too tight and too loose. The tendon must also be fastened to the periosteum surrounding the dorsal end of the osseous tunnel. The fixation obtained is highly satisfactory and it undoubtedly warrants this detailed description. The method is not, of course, original, having been observed in the work of Sir Robert Jones, and is a very valuable one.

When the peroneal tendons are to be transplanted into the tendo achillis, the preliminary

day. The necessity for adopting the Basle anatomical nomenclature terminology in anatomical references has not been recognized to any extent in recent literature although in most medical schools this is the only terminology taught. From personal experience one has realized the difficulty of trying to keep straight in his mind the different terms used to describe the same bone. The writer hopes to be pardoned for adhering strictly to the new terminology even at the expense of referring to certain well known operations by apparently new and unfamiliar names.

All operations designed to prevent lateral deformity of the foot are directed at the subtalar (subastragaloid) joints. Royal Whitman in 1901 described his talectomy (astragalectomy) with posterior dislocation of the foot as a method for producing lateral stability while still retaining useful flexion and extension in the ankle. It was a great surprise to the writer on examining some of the end results of this operation to find such satisfactory stability combined with a free range of flexion and extension when the operation in itself did not seem to be a good one from the standpoint of anatomical construction. Realizing that talectomy may not find favor with all surgeons the results obtained in certain cases label it as a highly satisfactory procedure. The peroneal tendons when active may be transferred to the tendo achillis to increase the power of plantar flexion.

Arthrodesis of subtalar joints by resection of the joint surfaces is more uniformly satisfactory in many hands. Dr. G. G. Davis is probably to be given credit for the principle of fusion of subtalar joints to produce lateral stability of the foot although the description of the Hoke operation in 1921 has a more scientific foundation. Fundamentally all operations of this type obtain fusion between the talus navicular (scaphoid) and calcaneus by resection or destruction of the articulating surfaces and are developed essentially upon the principles of the original Davis procedure.

Ryerson reporting his observations on a large number of cases which had been subjected to arthrodesis operations stated that his most successful tendon transplantations occurred in these cases. His description of a triple three joint arthrodesis gave an additional modification of the original principles. The three joint arthrodesis probably has the widest acceptance among orthopedists today. All cases about to be reported in this paper are of this type. The type of arthrodesis consisting of fusion between talus navicular calcaneus and cuboid bones has been performed. The results obtained in the ten hands have been most satisfactory.

Getting back to the question of transplanting tendons it has been stated that lateral muscles, if not paralyzed must be transplanted into the Achilles tendon or to the front of the foot. There are two chief reasons why this should be done. First a deforming force is removed from an undesirable position to one of correction and improved function. Second flexion and extension of the ankle joint may be obtained or improved by transplanting lateral muscles to the anterior or posterior part of the foot as indicated.

TECHNIQUE

The technique followed has been practically standardized. The approach to the subtalar joints is through a curved incision on the lateral side of the foot extending from the head of the talus backward and downward to a point one-half inch below and anterior to the tip of the lateral malleolus. If the peroneal tendons are to be transplanted to the front of the foot or to the Achilles tendon the incision is extended around the lower and posterior margin of the lateral malleolus and proximally up the leg along the course of the peroneal tendons for a distance of about 6 inches. After the fat interosseous talocalcaneal ligament and peroneum are removed from the sinus tarsi and the bony surfaces bounding it an excellent exposure of the subtalar and calcaneonavicular joints is obtained. The apposition surfaces of the anterior middle and posterior talocalcaneal joints are excised in the horizontal plane. The head of the talus is removed and the corresponding articular surface on the navicular bone is excised in the coronal or frontal plane. The calcaneocuboid articulation is likewise excised in the same plane. The excision of joint surfaces and the neck of the talus allows the foot to be dislocated ventroproximally upon the talus conforming to the requirements of good stability as suggested by Hoke. Valgus varus deformities of the foot can be corrected by turning the plane in which the various subtalar joints are excised. Two or three interrupted plain suture gut sutures are inserted to hold the foot in position. At this point on the talus the lateral muscles to the front or back of the foot as conditions indicate.

Only four groups of muscles will be considered in the foot at this time in an attempt to make the problem as simple as possible.

When the tibialis anterior is the only active muscle in the foot the deep flexor of the foot is used. If accompanied by the plantar posterior and calf muscles quadratus is the usual position. If

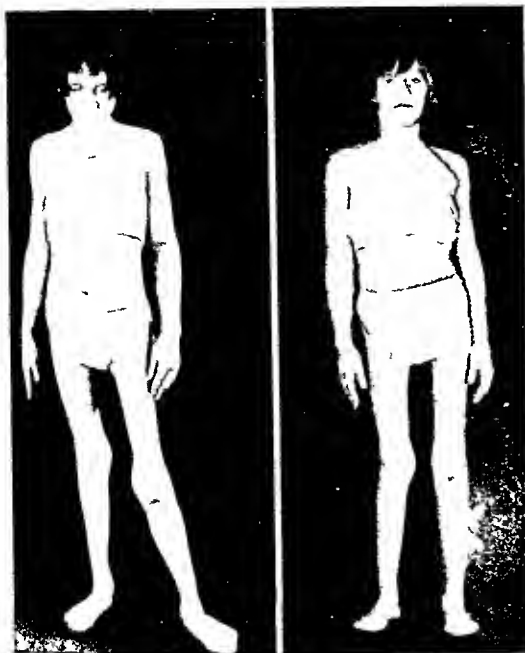


Fig 4 Case 3, E S, No 211. The view on the left shows the condition on admission. The bilateral talipes valgus is apparent and that on the left side is complicated by a contracture of the tendo achillis which the patient compensates for by advancing the foot slightly. All the weight is borne on the right extremity because of the paralysis of the left quadriceps femoris. The right view shows the condition on discharge. The valgus deformities have been overcome permanently and both feet are in position for good weight bearing as the patient demonstrates.

fect stability is present although not shown in this view. A permanent prevention of lateral deformity is assured and plantar flexion of 50 degrees with dorsiflexion of 90 degrees is possible. The transplanted tendon can be seen as a prominent ridge on the dorsum of the foot and ankle. The result is classified as good.

CASE 2, M, No 214, female, aged 8 years. Anterior poliomyelitis involving both lower extremities developed in 1924 at the age of 2½ years, and the patient was admitted 6 months later to the out patient department of the hospital, where her parents were instructed in physiotherapy including muscle training. A brace was applied to the left leg, but at the time of admission to the hospital for operative treatment the brace had not been worn for about 2 years. The right leg showed good power in the calf muscles, a trace of power in the invertors and good power in the peroneals, and, as a result, a very unstable foot in marked valgus was produced. On August 17, 1929, a subtalar arthrodesis with transference of the peroneal tendons from the outer side of the foot to be inserted into the medial cuneiform as previously described, was performed. Figure 2 shows on the left the right foot in marked valgus and, on the right, the good weight bearing lines obtained by the operation. Figure 3 demonstrates clearly the plantar flexion to 45 degrees and the dorsiflexion to 90 degrees which remained. It is regretted that photographs showing these positions before operation were not obtained.



Fig 5 Case 3, E S, No 211. The range of motion obtained by transplantation of the tendons of the peroneal muscles across the front of the right foot is clearly shown. This photograph was taken at an angle so that the true range of motion is not shown. Attention is called to the course of the transplanted tendon across the dorsum of the leg and foot as is shown in the lower view.

The excellent stability, freedom from lateral deformity, and useful range of motion label this as a good result.

A varus deformity of the left foot may be noted in Figure 2 also but, as this was treated by a different surgical procedure, no mention of it is made at this time.

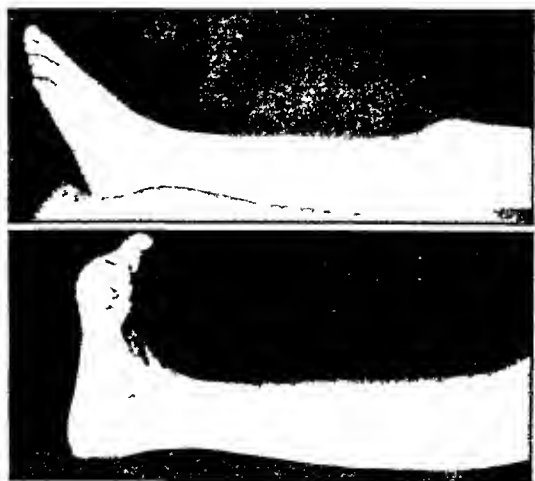


Fig 6 Case 3, E S, No 211. The upper view shows the range of active plantar flexion while the lower view shows the dorsiflexion. The contraction of the extensor tendons of the toes assists in the dorsiflexion of this foot.



Fig. Case N. 4. T. f the w ght bear g
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t b ted Th l f t t in moder tely se ru
p t I th right w th l t ght b g
p sit a ppar t



Fig. Case N. 4. Th m t factu d ru
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to th fro t f th foot sh Pl tar flex f 45
d b as th b h l th go d g es f d ruff
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tr ung m scl ca be se th d rum f th all
D ruff x thus t d by th p l l f th toe
t nores

preparation to ensure lack of angulation is observed before freeing the tendon as described. The method of fixing these tendons into the tendo achillis has been suggested by an operation described by Royle for inserting the posterior tibial tendon into this structure in certain cases of claw foot. With a large eyed needle the peroneus longus and brevis are laced back and forth through the tendo achillis and each other so as to lock the one into the other. One or two chromic catgut sutures are placed in these interlocked tendons and after placing a few No. 6 plain catgut sutures in the subcutaneous tissue the skin incisions are closed with an absorbable formalized catgut suture.

Attention must be called to a detail in the closure which is proving valuable in many recent cases. Incisions about the ankle in operations performed under tourniquet were found to be very much macerated and to have necrotic skin edges when the first dressing was done a week after operation. The probable cause for this is the tension of the wound produced by the oedema and hæmorrhage following release of the tourniquet when the wound was closed tightly. Following observations made by others the results obtained by closing the wounds with very few interrupted sutures so that marked tension would not occur in the wound have been very encouraging. There is rather marked staining of the plaster by the escap-

ing blood but the wounds are usually healed here dressed in a few weeks time.

CASE REPORTS

A few cases are to be reported briefly. Good results are classified according to the rules laid down by Steindler of (a) stability on weight bearing and (b) permanent prevention of lateral deformity and (c) more or less complete function of the transplanted tendon in its new line of action.

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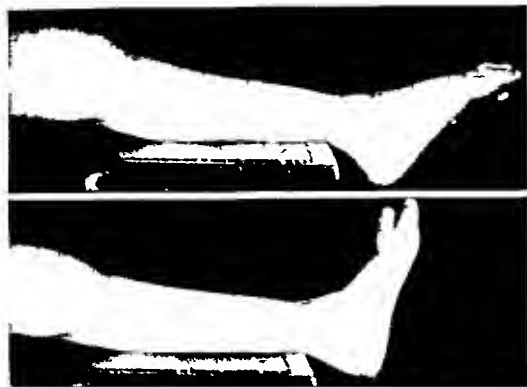


Fig 8 Case 5 I K, No 115 The degree of active plantar- and dorsiflexion which is possible in the left ankle following subtalar arthrodesis and transplantation of the peroneal tendons to the front of the foot is shown. The toe extensors are apparently assisting in the action of dorsiflexion. Stability and freedom from lateral deformity have also been obtained although no photographs have been obtained to show this.

able to walk with difficulty, dragging the left leg with the foot in marked valgus. One year later she was fitted with a brace and advised to wait a few years before any further treatment was undertaken. She was admitted to the hospital in May of 1930 for operative treatment. Examination on admission showed a marked valgus deformity of an unstable left foot. There was also a mild degree of contracture of the tendo achillis. The power in the calf muscles and peroneals was excellent whereas the anterior tibialis muscle was completely paralyzed. On May 4, 1930, a three joint subtalar arthrodesis with transference of the peroneal muscles to the region of the middle cuneiform was done using the usual technique.

The result obtained was very good as the stability was good, there was a permanent prevention of lateral deformities and the transplanted muscles allowed dorsiflexion to 90 degrees and plantarflexion to about 55 degrees. Figure 8 shows the degree of active plantarflexion and dorsiflexion resulting from the stabilization and transference of peroneal tendons. Unfortunately, photographs before operation are not available.

CASE 6 A J, No 169 female, aged 8 years. In 1927, anterior poliomyelitis developed at the age of 5 years, involving the left lower extremity. She had improved definitely following her illness which lasted only about six weeks until reaching the present residual stage of paralysis. No expert treatment had been received.

Examination upon admission to the hospital in 1930, 3 years after the onset of the disease showed the patient able to walk but the left foot was very unstable upon weight bearing, assuming a position of equinovalgus. The power in the calf was rated as "fair," the peroneals "good," while the anterior and posterior tibialis showed a mere "trace."

On June 14, 1930 a three joint subtalar arthrodesis with transference of peroneal tendons to the region of the middle cuneiform was done. Following the operation perfect stability free from the occurrence of lateral deformity with dorsiflexion of 100 degrees and plantar flexion of 50 degrees was obtained. The result is a good one (Fig 9).

Twelve additional operations performed upon 10 patients will not be reported as description would

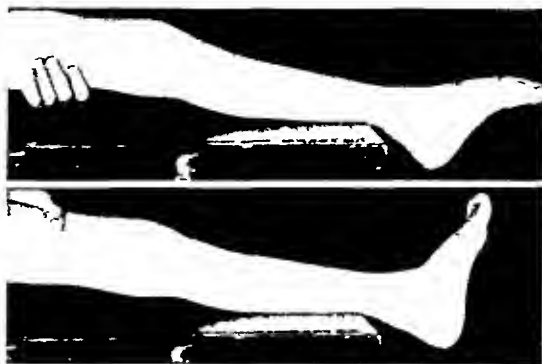


Fig 9 Case 6 A J, No 169 A photograph taken from the medial side of the leg and foot shows the degree of active plantarflexion and dorsiflexion in the upper and lower views respectively. The ridge caused by the contracting transplanted tendon as it crosses the dorsum of the ankle and foot can be seen in the lower view. The apparent prominence of the heel is in part due to the posterior displacement of the foot as recommended by Whitman, Hoke, and others, in their descriptions of stabilizing operations upon the feet.

be merely repetition. Briefly, in 11 of these operations the stability and freedom from lateral deformity was good. The function of the transplanted tendons was good in 10. One failure was obtained but this was not a bad result because the arthrodesis gave good stability. The twelfth case was discharged and did not return.

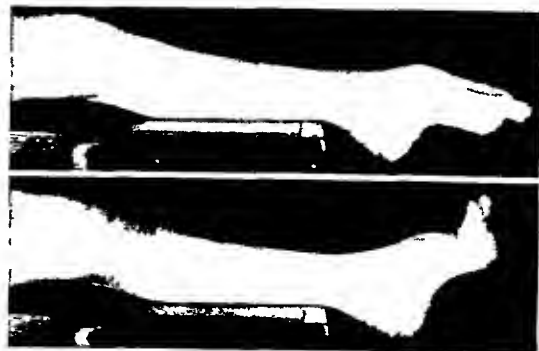


Fig 10 This and the succeeding view are offered as an example of the very satisfactory result obtained by transplantation of tendons with subtalar arthrodesis. In this figure the positions assumed by the foot in attempting dorsiflexion and plantarflexion are shown. The dropping of the heads of the metatarsals with cocking up of the toes on attempting dorsiflexion when the anterior tibial muscle is paralyzed is demonstrated in the lower view. Compare this with the result obtained following operation in the next figure.

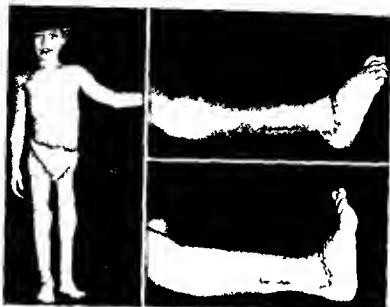


Fig 7 Case 4 V K N oo Th po tpe u ls btal ed f m btals
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must be transplanted into the tendo achillis or front of the foot as indicated

6 Children should be at least 6 years and preferably over 10 years of age before any bony operation is done

7 A brief consideration of the rules governing the transplantation of tendons is offered

8 Subtalar arthrodesis is described briefly

9 A change in the nomenclature of operative procedures to that taught at present in the medical schools is suggested

10 Six cases are briefly reported

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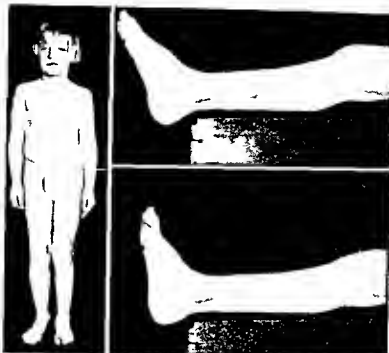


Fig. 1. A C. Th. d. ult. bta. ed by bial arthrodesis with t. plant. t. f. th. p. l. t. d. t. th. mddl. f. th. f. t. f. th. f. t. h. b. Th. f. t. w. th. l. f. h. w. wh. t. sud. dt. be. ell. tw. ht. be. ring. point. th. th. f. t. d. ectly. und. th. ght. b. r. g. m. f. th. l. g. th. b. f. l. t. l. d. f. mity. th. f. t. t. self. Th. w. f. m. th. f. t. f. d. th. ght. h. d. h. th. d. gr. f. t. plantar. and d. r. d. ex. which. po. sible.

CONCLUSIONS

Such a small series of cases as is here presented does not form an adequate background in itself for the formulation of an opinion as to the value of this operation. The experiences of others with this type of operation and personal observations upon three joint arthrodesis performed alone or combined with other procedures in the treatment of instability of the painful foot make it possible to testify regarding the value of the operation described.

The stability on weight bearing obtained by the three joint subtalar arthrodesis does not admit of any argument. The permanence of the correction of lateral deformity by arthrodesis depends upon the removal of deforming forces, has the motor or error muscles. The amount of motion obtained by utilizing the active lateral muscles depends to a great extent upon adherence to the rules outlined.

Arthrodesis of the subtalar joints should yield at least 90 per cent good results, the percentage being increased with added experience of the surgeon.

The poor results failure are almost without exception due to errors in judgment or operative technique.

SUMMARY

Final operative treatment in infantile paralysis should not be undertaken until the residual stage at least year after the onset of the disease has been reached.

2. In untreated cases deformities should be corrected after a period of conservative treatment by physiotherapy and mechanical fixation instituted before a joint operative treatment is undertaken.

3. Transplantation of tendons although attractive from theoretical standpoint has not proved satisfactory itself.

4. As stability of the foot with freedom from painful lateral deformities is the most desirable result, a operation designed to fuse joints through which the deformities occur should be performed.

5. A lateral muscles having useful position

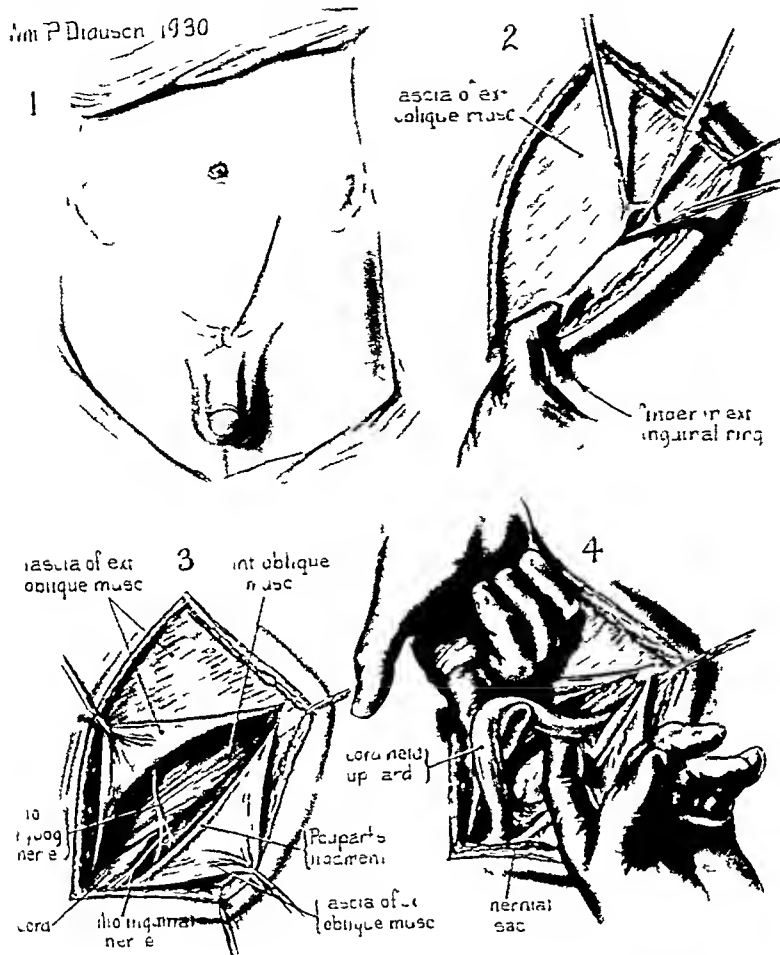


Fig 1 1, Location of incision, 2 point selected in separating the fibers in order to protect the nerves, 3, dissection of the external oblique, both nerves and cord exposed, 4, cord lifted out of the inguinal canal with a gloved finger, cremasteric being separated from its attachment to the internal oblique. Hernia sac protruding through Hesselbach's triangle

The treatment of type two offers little difficulty. Most cases are detected in childhood, and are cured if the sac is removed properly and the cord is allowed to fall back into its original position.

Taylor,¹ in a review of the Hopkins Hospital records, showed failure to cure in over 188 per cent of patients operated upon in this, the direct inguinal group. Before Taylor's report was published, my own failures in direct hernia operations by the Bassini method, occasionally reinforcing with the rectus sheath, convinced me that it was not altogether my fault. As a result of dissatisfaction, I evolved a method, the

principles of which, so far as I know, hitherto have not been utilized.

Before I describe the operation it would seem worth while to mention the need of prevention in connection with hernia. It is becoming increasingly difficult, as the result of laws of compensation in various states, for men below par physically to secure employment. In some of the states even though a hernia develops while the patient is in the discharge of duty, unless there is a definite history of accident, it becomes a personal responsibility.

Group one offers the greatest number of problems in this respect. Along with other pre-

¹Taylor A S Arch Surg 1920 1 38 400

OPERATION FOR DIRECT INGUINAL HERNIA

ELLIOTT H HUTCHINS M.D. F.A.C.S. B. TIM RE MAR. LA. 'D

THE problems presented by abnormal protrusion of a viscus through a normal or abnormal opening have not occupied as much space in modern literature as existing facts seem to warrant.

Traumatic surgery is not the most active department of general surgery at present certainly approaches that distinction. The spirit of the age is not only responsible for more accidents but for more serious accidents. Whether the type of hernia which I wish to discuss in this paper may be influenced by predisposing factors and is not entirely the result of a sudden violent tearing it must be admitted that in all probability repeated traumata play a part in dislocating the anous

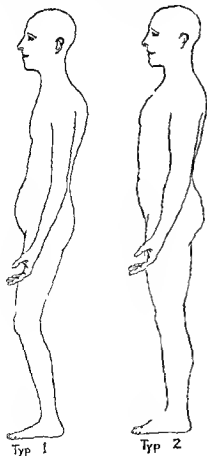
structures producing an abnormal opening and abnormal protrusion.

The two types of inguinal hernia provide the greatest number of hernia problems. The multiplicity of methods of treatment seems to be a confession of failure and offers for argument one or two premises. Either the existing pathological change has not been appreciated or faulty principles have been utilized in correcting the deformity. Confusion in the treatment of the two types is the result.

In the hope of clarifying these problems and for the purpose of formulating a method of cure especially for direct inguinal hernia a general study of those afflicted with inguinal hernia was made.

Briefly these patients may be placed in two groups. Type one represents the group to which this paper is chiefly concerned. The profile as made by me using the subject observed by the artist before the operation. The accompanying drawings were made from the same subject during the operation. In this group as a rule with exceptions the man is a boned or light built type; the body is more or less hairless; the non-resistant type; the skin sort of hangs; the head and neck seem to be supported too far forward; the chest is flat; the back is humped in the thoracic region; the epigastrium is flat; the hypogastrium is relatively prominent instead of the curvature being in the lower back to compensate for the thoracic deformity; the flat musculature is obviously especially in the lower abdomen where marked bulging may be seen over the inguinal regions especially when the patient coughs or when he lies on his back; the elevates his head from the pillow; the patient is typically viscerotonic; the thighs are flexed in the body and the knees are flexed; the distance between the ischium and the tip of the coccyx is appreciably lengthened; the gluteal muscles instead of giving a tight compact arrangement about the anus permit a loose excess which is also noticed when the perineum is examined digitally. From a careful examination of type one it is very apparent that when hernia exists one is dealing with a weak link in a weak chain.

Type two represents just the opposite of type one. If this type be the victim of hernia it will probably be because there is a weak link in a strong chain.



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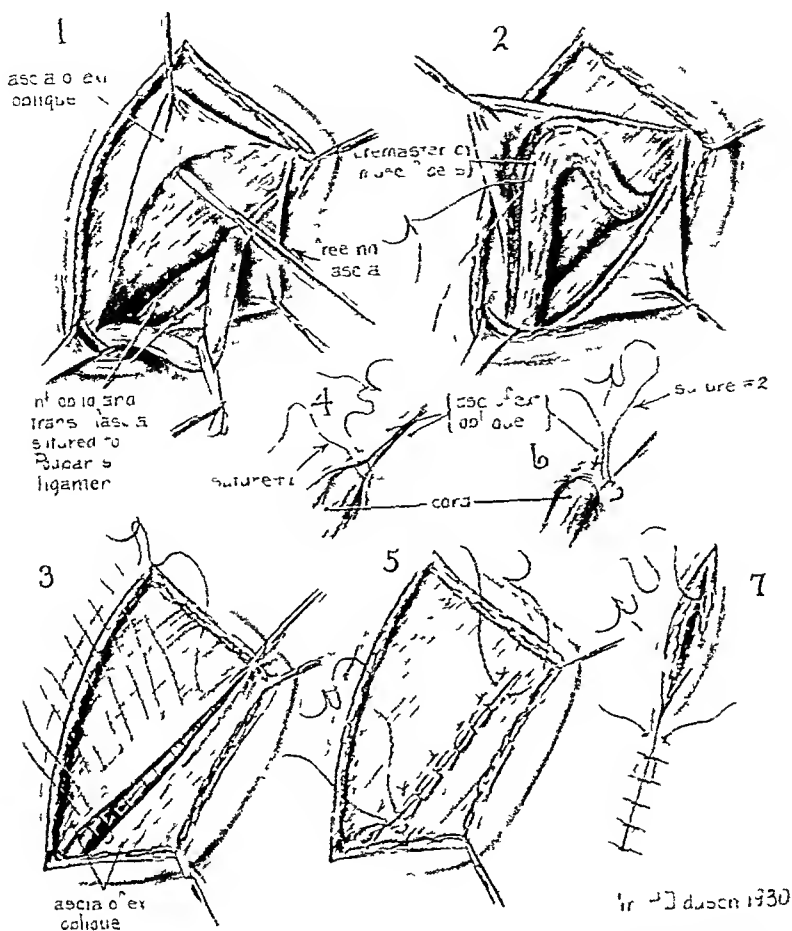


Fig 3 1, Internal oblique completely closed with a roll of muscle bundles so arranged that the knots of the sutures will be practically covered, the external oblique being freed more completely, exposing the semilunar line, 2, the cord being gracefully curved toward the midline, the cremasteric fibers being sutured to the internal oblique, following the direction of the semilunar line, 3 and 4, the lower flap of external oblique being drawn under the upper flap, with an extra suture overlapping the anterior segment of the ring, 5, upper flap overlapping lower flap, 6, the final suture in the external ring applied, 7, No. 0 catgut closing the deep fascia, silk-worm gut closing the skin

ment on one side and the external surface of the internal oblique to the linea semilunaris on the other. The cord is then dissected up with the gloved finger (Fig 1, 4), beginning at the external ring and gently lifting it out of the canal, liberating fibrous bands, and carefully guarding against damage to the blood vessels. The cremasteric muscle is then freed from its origin, to the extent necessary to gain sufficient mobility and length to permit the cord to function in the new field to which it will be transplanted. If the

cord is unduly massive, as a result of peritoneal fat or dilated veins, or as was found in a recent case, an old, quiescent, indirect sac, it is reduced in size by appropriate removal of the offending tissues. The sac, which at this stage can easily be seen protruding through Hesselbach's triangle, is then opened (Fig 2, 1). In this type of hernia, the sac is almost sausage shaped presenting transversely instead of end first. For this reason, it is unwise to attempt to transfix, amputate, and transplant the stump, as

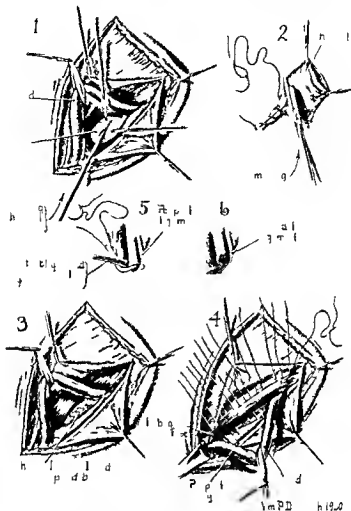


Fig. 1. The direct inguinal hernia. 2. The external oblique muscle is reflected. 3. The internal oblique muscle is reflected. 4. The external oblique aponeurosis is reflected. 5. The external oblique aponeurosis is sutured back.

entative measures it would seem wise that those potentially afflicted with hernia of the direct type should be fitted to the jbs and not be subjected to the physical violence that so often results in the formation of hernia. This could easily be done by examination before employment and group selection of light work and group training for heavier job.

OPERATION

Incision is made through the skin as far as possible toward the median line as subsequent dissection

of anatomical structures permit (Fig. 1). It is near the outer border of the sheath of the rectus abdominus muscle. The external oblique is then cleared of loose tissue and is being used to guard the inguinal and ilio-hypogastric nerves. To accomplish this the fibers of the external oblique (Fig. 2) are separated at the weakened point which begins above the usual location of the nerves. The cord is then exposed by gentle dissection with the gloved finger (Fig. 3) the flaps of the external oblique aponeurosis are directed back thus posing Poupart's ligament.

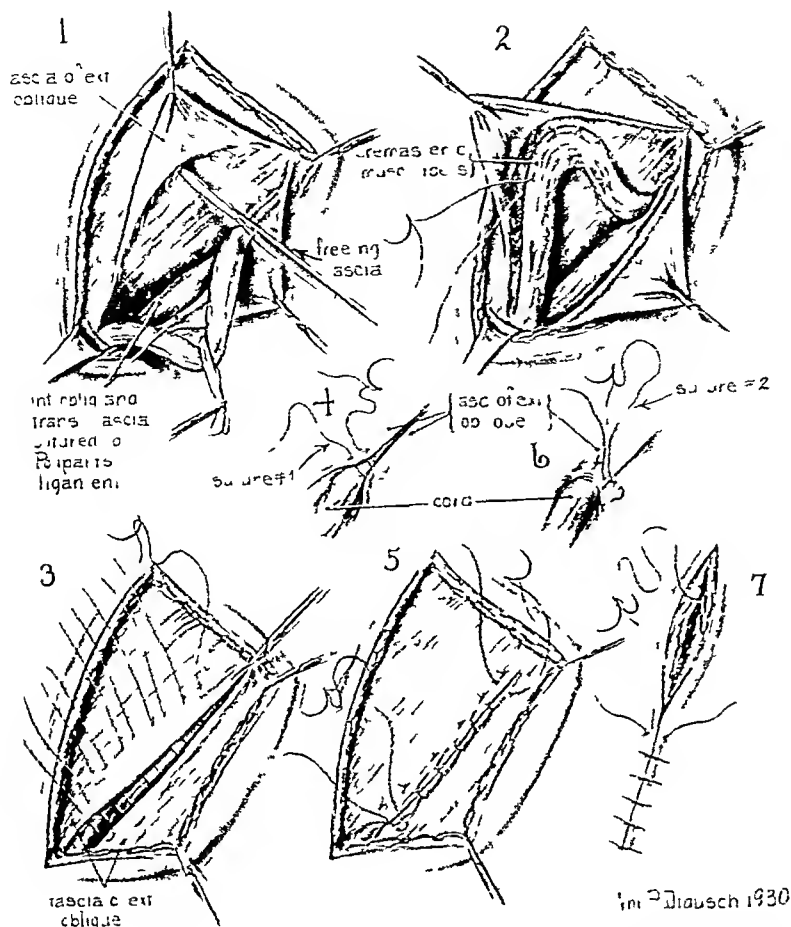


Fig 3 1, Internal oblique completely closed with a roll of muscle bundles so arranged that the knots of the sutures will be practically covered, the external oblique being freed more completely, exposing the semilunar line, 2, the cord being gracefully curved toward the midline, the cremasteric fibers being sutured to the internal oblique, following the direction of the semilunar line, 3 and 4, the lower flap of external oblique being drawn under the upper flap, with an extra suture overlapping the anterior segment of the ring, 5, upper flap overlapping lower flap, 6, the final suture in the external ring applied, 7, No. 0 catgut closing the deep fascia, silk-worm gut closing the skin

ment on one side and the external surface of the internal oblique to the linea semilunaris on the other. The cord is then dissected up with the gloved finger (Fig 1, 4), beginning at the external ring and gently lifting it out of the canal, liberating fibrous bands, and carefully guarding against damage to the blood vessels. The cremasteric muscle is then freed from its origin, to the extent necessary to gain sufficient mobility and length to permit the cord to function in the new field to which it will be transplanted. If the

cord is unduly massive, as a result of peritoneal fat or dilated veins, or as was found in a recent case, an old, quiescent, indirect sac, it is reduced in size by appropriate removal of the offending tissues. The sac, which at this stage can easily be seen protruding through Hesselbach's triangle, is then opened (Fig 2, 1). In this type of hernia, the sac is almost sausage shaped presenting transversely instead of end first. For this reason, it is unwise to attempt to transfix, amputate, and transplant the stump, as

suggested by Kocher in an indirect hernia. On the left side the sigmoid and on the right side the cæcum and even the urinary bladder may be injured therefore the sac is opened sutured and divided in full view (Fig 2 3). The stump is closed and dropped back (Fig 2 3). The internal oblique and transversalis fascia are then sutured to the base of Poupart's ligament (Fig 2 4) as far back toward the abdomen as possible (Fig 2 5) an attempt being made to make this part of the abdominal wall lie inward instead of outward. The rows of knots of chromic catgut are so placed that the muscle bundles of the internal oblique practically hide them (Fig 2 6) and prevent their contact with the next layer the aponeurosis of the external oblique. It will also be noted that the sutures are so placed that they do not strangle the muscle bundles (Fig 3 1).

The cremaster muscle is then sutured in a manner that will cause the cord to be spread out in a fan like arrangement (Fig 3 2) from the point

at which it emerges through the internal ring curved across and fastened to the outer surface of the internal oblique until it reaches the semilunar line thence along that line to the external ring. The cremaster in its new position not only flattens the cord and produces a valve-like slit of the internal ring but also removes the weakening

influence of the cord from the inguinal canal thus permitting the internal and external oblique to act as adjutants to each other and in addition suspending the testicle thus diminishing the chances of venous embarrassment. The external oblique (Fig 3 3) is then sutured in a way that permits an overlapping of the anterior (Fig 3 4) and weak segment of the external ring (Fig 3 5 and 6) however the final arrangement of the external ring. After the subcutaneous fascia is closed with fine catgut the skin is closed with interrupted silk worm gut (Fig 3 7).

If there has been a recurrence following this method I do not know of it.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.
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JUNE, 1932

THE PROBLEM OF THE STIFF JOINT

KNOWLEDGE can be acquired by many but wisdom is more elusive and its acquisition is limited to a few. Occasionally, from a wealth not only of sound knowledge, but also of large and varied experience, some one pours forth in his teaching wisdom that is so fundamental and simple that all who hear must heed. Sir Robert Jones, in his William Mitchell Banks Lecture¹ in Liverpool, 1931, demonstrated such wisdom.

The lecture covers a large subject in a comprehensive manner, takes up in orderly fashion and deals squarely with such problems as joint adhesions, the question of rest or movement, the prevention of stiffness, stiffness following fractures in and about joints, treatment of stiffness due to arthritis, prolonged immobilization of a fractured limb, active and passive movements, myositis ossificans traumatica and ischaemic palsy. Sir Robert gives his own technique of forcible manipulation for treatment of the various joints such as those of the knee, shoulder, and elbow, and

his treatment of acute suppurative synovitis, rheumatoid disorders, and fixed ankylosis. Such a group of conditions is not considered in textbooks, so the article is invaluable. The subject matter is most clearly presented in Sir Robert's inimitable style.

Sir Robert called attention to the fact that in England the "irregulars," the "bone setters," are too often attempting to relieve conditions that should be cared for by members of the medical profession. It is futile, he said, for the medical profession to cite the numerous failures and the injured joints for which bone setters may have been responsible. It is far better to inquire into their successes and the cause of them concerning the care of stiff joints. "The ordinary textbook," he declared, "if it deals with the question at all, does so in an indefinite way, and invariably leaves us without practical guidance, as a sequel to this we have unqualified practitioners all over the country who render stiff joints mobile with a success sometimes very disconcerting."

The lecturer emphasized that a stiff joint is generally due to the presence of adhesions, within or around the joint, often adhesions are present in both places. An adhesion is at first merely a pathologic band, restricting movement between adjacent tissues, it arises from a serous or haemorrhagic exudate, either inflammatory or traumatic. This band becomes fibrous, loses vascularity and elasticity, and becomes in reality a cicatrix. An inflamed joint kept at rest too long after inflammation has subsided permits of the formation of unnecessary cicatricial bands. A joint stiffened by simple adhesions, whether

¹ The problem of the stiff joint. Brit. M. J. 1931 December 5.

intra articular or extra articular should be moved whereas a joint stiffened by arthritis should be kept at rest until pain and inflammation have subsided. To quote again: A joint whose movement is limited in all directions is or has been subject to arthritis while a joint which is limited in certain directions only movements being normal in others is not arthritic.

In dealing with differential diagnosis Sir Robert stated: Definite localized pain is experienced when adhesions are put on strain and the tenderness can generally be localized on pressure. It is more diffuse in arthritis. An adhesion is most painful when a joint is moved and less so when the joint surfaces are pressed together. In arthritis pain is more pronounced when pressure is brought to bear on the bone surfaces. The temperature of the arthritic joint is usually increased over the whole articulation while adhesions may produce localized surface temperature but generally there is none. In arthritis the stiffness is progressive in adhesions it is stationary or retrogressive.

In speaking of tuberculosis of joints of the adult Sir Robert emphasized the seriousness of the problem and although after prolonged conservative measures with constant danger of dissemination quiescence may be obtained in reality ankylosis is required. For this reason as soon as an accurate diagnosis is made of tuberculosis of the ankle, knee or hip he advises except for children an operation which will result in ankylosis.

The article should be read by all surgeons having anything to do with surgery of the extremities. It is of particular interest to the orthopedic surgeon for in it he will find crystallized into definite observation his experiences. The larger his experiences the more enthusiastic will be his reception of such a lecture.

MELVIN S. HENDERSON

THE RECOGNITION AND TREATMENT OF SURGICAL SHOCK

THE work of Blalock and his associates and of Parsons and Phemister has served to stress the significance of blood loss in the production of shock. They have adequately shown that a satisfactory explanation for the depressed arterial pressure accompanying traumatic shock is to be found in the amount of blood lost into the injured tissues. The fall in blood pressure attending the release of a tourniquet upon a damaged extremity is due not to the absorption of a histamine-like substance from the injured tissues but to bleeding through the leaky vessels of the injured extremity.

The symptoms of shock are those of hemorrhage. A burned pulse and a depressed arterial blood pressure are the most significant signs. Rarely shock obtains when the pulse rate is normal. The blood pressure is the most reliable guide in determining whether shock is present. A patient with a systolic blood pressure of 100 or less after severe injury is in potential shock. When the pressure is 90 or less the patient is in actual shock and energetic treatment should be instituted. At the critical level of blood pressure 70 millimeters mercury an inadequate blood flow is afforded the vital centers which if continued for a few hours will terminate fatally despite energetic eleventh hour expedient.

An array of widely differing conditions better described as instances of syncope, collapse or prostration are not infrequently erroneously labelled shock. In the dramatic catastrophe consequent upon perforation of a duodenal ulcer this confusion is well illustrated. Severe prostration is uniformly present, shock almost never. The pulse may be slightly quickened but the blood pressure is normal.

The rationale of treatment in shock consists of measures that replenish the depleted blood

volume Adequate hæmostasis should be secured as quickly as possible In operations of election, careful deliberate hæmostasis is the best prophylaxis against shock Relief of pain, the application of external heat, and the free oral administration of warm fluids are symptomatic aids of great value In the transportation of the injured, good immobilization of fractured bones is important in order to avoid or not to aggravate existing shock Mild cases of shock respond favorably to intravenous administration of saline and the subcutaneous injection of ephedrin There is no vasomotor exhaustion in traumatic shock, the value of vasospastic agents is limited to the treatment of mild shock and in determining whether other measures are necessary In the fall of blood pressure accompanying spinal anæsthesia and that occurring after sudden removal of large quantities of fluid from the body cavities, the administration of vasospastic agents is urgently indicated, for in these conditions there is an actual lowering of the tone of the vessels In these conditions too, the Trendelenburg posture has its greatest value In traumatic shock, elevation of the foot of the bed and the Trendelenburg posture are of little value because little blood is mobilized from the constricted peripheral vessels by this maneuver and the blood is not in the venous reservoirs

Glucose solutions are of no greater value than saline in the treatment of shock There is no deficiency in the blood sugar and glucose in solution is a crystalloid and diffuses through semi-permeable membranes Only a colloidal solution having the same osmotic pressure as blood will remain in the vessels A 6 per cent aqueous solution of acacia which is now generally available exhibits this feature and is far superior to saline

Even though patients in shock suffer more from depletion of the blood volume than from

want of oxygen carriers, the most effectual means of restoring a diminished blood volume is transfusion of blood In severe shock, preparation for transfusion should be made immediately, the temporary tortuizing intravenous infusions of saline and acacia being given meanwhile In the treatment of severe shock adequate replacement of the diminished blood volume is the significant factor A single transfusion of 800 cubic centimeters of blood may be ineffective, when the blood loss has been great, several transfusions are in order In shock, transfusion of unmodified blood by the Kimpton-Brown tube method has the advantage that a large transfusion can be given quickly with little cooling and with practically no trauma to the blood and consequently without reaction At the University Hospital, over a seven year period, the blood grouping of convalescent cases that could well give blood (hernia, fracture cases, etc) has been routinely determined after operation and satisfactory donors are always available In those instances in which urgent necessity does not permit cross matching, group IV donors have been used with complete satisfaction Many lives have been saved by this measure of preparedness OWEN H WANGENSTEEN

SIR HENRY WELLCOME HONORED

AT a recent meeting of the Council of the Royal College of Surgeons of England, The Right Hon Lord Dawson of Penn, physician to His Majesty the King, and president of the Royal College of Physicians of London, and Sir Henry Wellcome, founder of The Wellcome Research Institution, were elected honorary fellows of the Royal College of Surgeons

The bestowal of this signal honor upon Sir Henry Wellcome is a special one Aside from members of the Royal Family, he is the second

person not holding a medical degree upon whom this rare distinction has been conferred. The first and only other recipient was Field Marshal Lord Roberts of Kandahar.

Sir Henry Wellcome is of American birth and known for his world wide scientific work extensive researches in connection with trop-

ical diseases. He founded the Wellcome Tropical Research Laboratories at Khartoum on the Upper Nile regions of the Sudan Africa. He is also director of the Gorga Memorial Institute Washington D C and its Tropical Research Laboratories at Panama.



FRANK F BUNTZ
1861 1928

MASTER SURGEONS OF AMERICA

FRANK EMORY BUNTS

ON November 26, 1928, Dr Frank Emory Bunts, a master surgeon, died suddenly from heart disease. His death brought a deep sense of loss not only to his many friends and associates among the physicians of Cleveland, but also to physicians, friends, and former patients throughout the world, who have at some time come under the influence of his kindly and genial spirit.

Dr Bunts was born in Youngstown, Ohio, in 1861, and received his education in the public schools. He then entered the United States Naval Academy at Annapolis, from which he was graduated with high rank in the class of 1881. All through his life and in all his relations he always bore the stamp of the navy.

After Dr Bunts had served for two years with the Asiatic fleet, the opportunity was given the younger naval officers to resign, because the navy was overstaffed, and the young man decided to study medicine. After his graduation from the Medical School of Western Reserve University in 1886, he became house officer at St Vincent's Charity Hospital, with which institution he was associated in various capacities for the rest of his life—42 years.

Twice Dr Bunts interrupted his practice to study in foreign clinics. In the Spanish-American War, he served as surgeon to the First Regiment of Ohio Cavalry. He always retained his interest in military affairs and after the war, in the midst of a busy practice, he became captain of Troop A of the National Guard of the State of Ohio and served in this capacity for three years. At the time of the World War he again accepted a commission as Major, later becoming Lieutenant-Colonel, commanding General Hospital No. 9 at Rouen, France (Base Hospital No. 4, U. S. Army).

Dr Bunts was the first president of the Cleveland Academy of Medicine and also served as president of the Cleveland Medical Library Association in 1927. He was a member of the American Surgical Association, the Ohio State Medical Society, the American Medical Association, the American College of Surgeons, the American Association for the Prevention of Cancer, the Société Internationale de Chirurgie, and the Société Française pour l'Avancement de Science.

From 1886 to 1893, Dr Bunts lectured on surgery at Wooster Medical College, and from 1893 until the time of his death he was professor of principles of surgery and clinical surgery at the Western Reserve University School of Medicine. He

was visiting surgeon at various times to St. Alexis Hospital, St. Anne's Maternity Hospital, Mt. Sinai and the Cleveland City Hospital, consulting surgeon to the Lutheran Women's and Maternity Hospitals. He was one of the founders of the Cleveland Clinic Foundation and was chief of staff at St. Vincent's Charity Hospital from 1913 until his death.

In 1888 Dr. Bunts married Miss Harnett E. Taylor. They had two children--Dr. Alexander Taylor Bunts and Clara Louise Bunts, wife of Edward C. Daoust.

It is difficult properly to evaluate this man. He possessed so many characteristics which make for greatness combined with a retiring, unassuming personality. Perhaps one may safely state that the keynote of his character was his loyalty and constancy. His patients, his friends, the institutions he served all attest this fine quality.

Among Dr. Bunts' salient characteristics was his deep interest in civic and national affairs. He was a member of the Chamber of Commerce and served for years on its Committee on Military Affairs. He was a director of the Cleveland Trust Company. He was interested in and furthered movements for civic improvement and was a frequent lecturer on patriotic subjects. He was a man of broad culture and wide reading. His numerous medical articles and the small volume of stories which he published some years ago have a characteristic individual charm. He was an enthusiastic fisherman and the month spent at Rose Point each year provided many anecdotes which were a constant delight to his friends.

An emphatic word should be added about his influence as a teacher upon the students with whom he came in contact in the medical school and in the wards of the hospital. Patience and understanding with insistence upon accuracy in diagnosis and refined surgical technique in operating were outstanding characteristics of Dr. Bunts the teacher.

There are certain individuals who possess the rare quality of binding to ether those with whom they are associated due to high intelligence, industry, uncompromising justice, fidelity, patience, a deep understanding of human frailties and unfailing friendliness. Such a man was Dr. Bunts. GEORGE W. CRILE

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

AN excellent atlas¹ and text on the roentgenology of the urinary tract, bringing the reader abreast of progress in this field of roentgen-diagnostics, is that of Joseph and Perlmann. After the usual chapter on X-ray technique and apparatus, the authors proceed to a detailed description of the normal urinary tract, as seen in the roentgen films, with full reference to the influence of respiration, peristalsis in the ureters and renal pelvis, and the emptying of the bladder. Stress is laid upon the advantage of small ureteral catheters over large ones. Urinary tract pathology is then considered at satisfactory length. Intravenous urography is described and discussed and the relative value of retrograde over intravenous pyelography carefully considered. Numerous instances are cited in which the intravenous method seems superior.

The illustrations constitute a splendid reference atlas, which, because of the explanatory notes in four languages (German, English, French, and Spanish), should appeal to a very large number of radiologists and urologists throughout the world. With rare exceptions the cases were verified at operation. The section on the bladder is exceptionally interesting.

JAMES T. CASE

A DELIGHTFUL story of a Kentucky physician of the 70's and 80's.² The author writes of his father—sympathetically, yet without an obvious eulogistic tinge that would have destroyed the charm of the picture. Nevertheless, the reader senses the joy with which the son describes his father's admirable traits of character and his great success in practice. One reaches the last page with regret, he has been carried through a simple, sincere narrative that might have been prolonged with profit to at least double its length.

Robert B. Pusey lived with the ideals of his profession ever in the foreground, he served well. The hills and the valleys, the woods and streams were to him an unending source of delight, intimately interwoven with the tasks of the day.

In addition to its biographical features, the narrative is of value as it presents a clear picture of medi-

cal education and medical practice of the period. Numerous quotations from letters add a distinctly "source" character. Altogether it is a charmingly written narrative of a worthy man.

The publisher is to be congratulated upon an attractive format.

IRVING S. CUTLER

THE popularity of Dr. McPheeters' book on varicose veins³ is attested to by the publication of a third edition within 2 years. It is a most comprehensive survey of the entire subject of varicose veins of the lower extremity with special reference to the injection method of treatment.

The author reports some excellent experimental work done on the venous flow in varicose veins. By means of lipiodol injections into the varicosities and observation under the fluoroscope he shows that the blood current in large varicosities of the great saphenous vein of the thigh is stagnant or flows downward away from the saphenofemoral opening, the blood eventually emptying into the deep system of veins through the communicating branches. From this experiment and from clinical experience Dr. McPheeters believes that the rare incidence of pulmonary embolus following the injection treatment, but four cases reported in the literature, is due to the fact that an embolus formed in a peripheral varicosity will be arrested by the communicating branches which are smaller than the superficial varicose veins.

The advantages and disadvantages of the various sclerosing solutions are discussed at length. The solution used most frequently by the author is a combination of sodium chloride, invert sugar, and cane sugar with phenylcarbinol. As he attempts to thrombose all veins at one sitting with multiple injections large doses of this non-toxic solution may be given. He believes that quinine and urethane should be used for obliterating the occasional veins that are left, this solution being too toxic for large doses. This solution of quinine, however, has been used extensively and satisfactorily by other men who do not follow Dr. McPheeters' technique of multiple injections at one sitting and who believe that the patients are more comfortable if single injections of this solution are given over a period of

¹ FORTSCHRITTE AUF DEM GEBIETE DER ROENTGENSTRAHLEN. Edited by Dr. Grashey. Vol. xxxvii.—DIE HARNORGANE IM ROENTGENBILD. By Prof. Dr. Eugen Joseph and Dr. S. Perlmann. Berlin. 2d rev. ed. Leipzig: Georg Thieme, 1931.

² A DOCTOR OF THE 18, 20'S AND 80'S. By William Allen Pusey. Springfield, Illinois: Charles C. Thomas, 1932.

³ VARICOSE VEINS WITH SPECIAL REFERENCE TO THE INJECTION TREATMENT. By H. O. McPheeters, M.D., F.A.C.S. 3d ed. Philadelphia: F. A. Davis, 1931.

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JOHN S COUL E

DIS ELEKTROCHE GIZ. B P r f D n K e ser Leipzig
Fach Medicinac B handlung

AGAIN Dr Graves has favored the profession with a timely contribution from his delightful pen *Female Sex Hormonology*¹ is a review of the subject from its incipency. Covering only one hundred pages, it presents concisely the 1931 status of female sex hormones in a clear, readable, and interesting manner. Although this review is primarily intended for students and classroom teaching, it has real value for the profession at large, many of us "do not have ready access to a literature which is scattered in technical and foreign journals."

This book is introduced by a short chapter on the early history of female sex hormonology. This is followed by a discussion of sexual cycles in animals, sex cycles in the ovary, and sex cycles in the human uterus. Then Dr Graves proceeds with the story of the search for hormones of the ovary, the discovery of the hypophysis as an agent in the sexual and reproductive cycles, and the problems involved in the separation of the various pituitary hormones. Three enlightening chapters are devoted to new theories of menstruation, parturition and lactation. He is fair and honest in the chapter on organotherapy, although it will undoubtedly prove disappointing to those men who are looking for a panacea in the treatment of endocrine disorders in women.

A glossary and an excellent bibliography conclude the book. This glossary gives one, at a glance, ready access to the new terms and ideas which recent investigations have introduced in the field of endocrinology as applied to women. The bibliography has been carefully selected and will serve as an invaluable addition to those who are interested in delving deeper into the original studies and experiments which the author has so brilliantly compiled.

With further discoveries in endocrinology, new work in physiological chemistry, and advances in the practical application of discoveries already made, there soon will be a place for new editions of this book. I shall await them with keen anticipation. But for today, and the immediate future, it has a great practical appeal and fulfills Dr Graves' plan "to furnish a concrete picture of a complex subject."

GEORGE H. GARDNER

BOTH Dr Osgood and Dr Allison are well known for their excellent writings on the subject of orthopedic surgery. In their new contribution² they offer the reader a collection of lectures written especially for the advanced medical student and the general practitioner. They have tried to impart information as to the diagnosis and the treatment of diseases and lesions which are included in the subject of orthopedic surgery. They present the subject to the practitioner in order to help him to act intelligently in applying first aid and in recognizing various lesions and their underlying causes.

The lectures have been rewritten several times during the past 6 years. The authors believe that class exercises in a specialty should include the fundamentals upon which depend reasonably accurate diagnoses and indicate immediate, appropriate treatment. They supplement the exercises by clinical work given to small groups of students.

These lectures reflect, to a considerable degree, much of the teachings of the late Dr Robert W. Lovett.

The plan recommended by the authors is as follows. Each lecture is mimeographed and a copy is given to each student one week before the class exercise at which the subject contained is to be discussed. The students are advised to read each lecture and take notes therefrom, after which, the lecture is signed and returned before the exercise is given. The hour of the exercise is divided into three periods of twenty minutes each. During the first period which is called visual approach, the subject is amplified by the demonstration of clinical cases, pathological specimens and lantern slides. During the second period, called the deductive approach, the student is permitted to ask the lecturer questions relative to the written lecture previously given, and the clinical demonstration. During the third period, called the eductive approach, the students are quizzed on the written lecture.

The twelve lectures include the following general joint phenomena, the reactions of developmental and adult bone, nutritional and growth disturbances, congenital deformities, cerebral and spastic palsy, obstetrical paralysis, Volkmann's deformity, Dupuytren's contracture, scoliosis, tuberculosis, anterior poliomyelitis, chronic rheumatic arthritis, traumatic affections of joints and bursæ, the relation of orthopedic surgery to industry, and body mechanics and statics.

In general, the three main causes for tissue changes in bones and joints are given as trauma, infection, and toxins. Arthritis is divided into Type I—atrophic arthritis, and Type II—hypertrophic arthritis.

Teachers of orthopedic surgery generally would consider that this subject cannot be covered in 12 lectures. The brief description of epiphyseal disturbances and especially their treatment would be criticized by most teachers. The reviewer was surprised to find no statement concerning the use of convalescent serum in the treatment of infantile paralysis in spite of the fact that the authors state that the orthopedic surgeon has no place in the treatment of this disease before paralysis occurs.

The authors use the term "obstetrical paralysis" for which the term "brachial birth palsy" would be a welcome substitute. In the discussion on Dupuytren's contracture, no mention is made of the important work of Kanavel.

The conception of the authors brings up an interesting pedagogical experiment which might be used as a guide for other teachers for this and other specialties.

PHILIP LEWIN

¹FEMALE SEX HORMONOLOGY. A REVIEW. By William P. Graves. A.B. M.D. F.A.C.S. Philadelphia: W.B. Saunders Company 1931.

²FUNDAMENTALS OF ORTHOPEDIC SURGERY. IN: GENERAL MEDICINE AND SURGERY (HARVARD LECTURES). By Robert B. Osgood, M.D., F.A.C.S. and Nathaniel Allison, M.D. F.A.C.S. New York: The Macmillan Company 1931.

AMERICAN COLLEGE OF SURGEONS

THE ANNUAL OBLIGATION OF A LITERARY AND CLINICAL SURVEY

SPRING in a rural community marks the beginning of a period of unremitting labor,—plowing, planting, and cultivation,—arduous toil, holding out, however, the promise of a bountiful harvest in the Summer and Fall. To speak in the late Spring of making hay in the domain of medicine and surgery is as irrational as in the life of a rural community,—but in both situations it must be remembered that the harvest is dependent upon the activities of the preceding season. If the surgeon or internist is to meet the demands of the Fall months as completely equipped as possible for that very active period, it is well for him to prepare himself by making a careful survey of the cases which have been under his care during the past year. An investigation of his cases by groups will show him whether his records are sufficiently complete and accurate in every instance, whether the daily noting of certain additional factors might not have led to definite conclusions in a selected group of cases, or whether in other instances a slight change in technique would have produced a better end-result—a more perfectly functioning member. A study of the cases in the practice of an individual surgeon or the analysis of a series of similar cases in a hospital or clinic will stimulate interest and lead to the determining of valuable conclusions.

If the study is being carried on in a small hospital, where co-operation is the watchword of the institution, or in a larger one, where such a spirit is perhaps even more important, the investigation can assume such proportions as to involve practically all departments of the hospital medicine, surgery, X-ray, anæsthesia, dietetics, record room, etc. The active co-operation of one or more representatives from each of the above mentioned staffs will contribute extensively to the success of the analysis both from the point of view of the consideration of the data actually available from the present records and also with respect to the presentation of practical suggestions for the modification of the records with the addition, elimination, and rearrangement of data so that the future study of other groups of cases may be facilitated.

Whether the more extensive investigation is

undertaken or the simpler analysis of a group of cases under the doctor's own supervision, the individual or staff making such a study will need to be familiar with the details of other surveys. He will wish to know what points were considered important by other men in this country and abroad who have made similar analyses and what their conclusions may have been. He will be interested in knowing in how many of a certain series of 168 cases the end-results were improved and the reason for the exceptions. Whatever his problem it will be necessary for him to be familiar with the medical literature and in this phase of his study the Department of Literary Research of the College can be of assistance to him.

The staff of workers maintained by the Department of Literary Research of the American College of Surgeons is equipped to obtain from the medical literature whatever data is required by the professional man engaged in reviewing the literature in conjunction with an analysis of his cases or any other scientific study to which he may be devoting his attention. The staff includes workers trained in the preparation of bibliographies, abstracts, and translations upon medical subjects. If references are desired to articles on a specific subject, these can be supplied by the department covering the medical literature for any period of years as indicated by the one submitting the request—one, two, ten, or twenty years, or back to the beginning of the work on this subject. In some instances it is necessary to prepare a working bibliography upon a general subject and to check these references so as to eliminate the extraneous material and include brief notations upon the references in point. Whatever the need of the investigator in this field, it can be supplied by this group of trained workers experienced in gleaning data from the medical literature.

If abstracts and translations are desired, workers in the various foreign languages can provide them including material from the German, French, Spanish, Italian, Dutch, Russian, and Scandinavian languages. If it is advisable to have a complete translation from the foreign publica-

tion this can be provided. If abstracts covering specified points only are necessary the data can be furnished in accordance with the wishes of the one making the request.

It is the aim of the department to supply the needs of the investigator in so far as the medical literature affords opportunity. To facilitate the service of the department blanks will be supplied upon request. The blank affords an opportunity for a definite statement of the subject and the type of research desired: bibliography, abstracts and translations, or package library. (The package library is a loan service which is free of charge. It includes those reprints which are available in the College collection. The material in this collection is not complete on any one subject although in many instances it contains sufficient material for the speaker who is to make a brief

address or discuss the paper of another investigator.) The blank also gives an opportunity for indicating the phases of the subject which are of particular interest, the date at which the material is desired, and the appropriation which the investigator wishes to spend upon the research. With a specific date in mind at which the completed material is desired and a definite appropriation stated, the department will furnish as much data as possible for the time and money allotted in each instance. It is the aim of the department to furnish an accurate and scientific service as complete as the individual investigator may desire—that any member of the profession wherever he is located and however much he is pressed for time may have the advantage of a survey of the literature as a background for the study of his own cases.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ALLEN B. KANAVEL, Chicago, *President*

J. BENTLEY SQUIER, New York, *President-Elect*

FRANKLIN H. MARTIN, Chicago, *Director-General*

EVARTS A. GRAHAM, St. Louis, *Chairman, Committee on Arrangements*

PRELIMINARY PROGRAM FOR THE ST. LOUIS CLINICAL CONGRESS

IN the following pages will be found a preliminary program of the clinics and demonstrations to be given in the hospitals and medical schools of St. Louis during the twenty-second annual Clinical Congress of the American College of Surgeons, October 17-21 as prepared by the Committee on Arrangements. The surgeons of St. Louis are keenly interested to provide a complete showing of the surgical activities of that city, with its two splendid medical schools and many fine large hospitals.

The final program will include operative clinics and demonstrations in all branches of surgery—general surgery, gynecology, obstetrics, orthopedics, urology, proctology, and surgery of the eye, ear, nose, and throat. It will be noted that clinics are scheduled for the afternoon of Monday, October 17, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days.

The program as published at this time is merely an outline or basis for the final program. During the months preceding the Congress the hospital schedules will be revised and amplified under the direction of the Committee on Arrangements so that in its final form the program will present a completely detailed schedule of the clinical work to be demonstrated.

A demonstration of the modern methods in the treatment of fractures will be a feature of the clinical program. At several of the hospitals plans are being made for a comprehensive showing of the various methods used and the results obtained in the treatment of fractures which form so large a part of the surgical work in large cities and industrial centers. Other important features of the clinical program include demonstrations in the treatment of cancer by surgery, radium and X-ray, the rehabilitation by surgery and physiotherapy of patients injured in industrial, railway, and automobile accidents, etc.

EVENING MEETINGS

An outline of the programs for a series of five evening meetings to be held in the ballroom of the Jefferson Hotel, as arranged by the Central Executive Committee, will be found in the following pages. At the presidential meeting on Monday evening the president-elect, Dr. J. Bentley Squier, of New York, will be inaugurated and deliver the annual address. This will be followed by the John B. Murphy oration in surgery by Sir William I. DeCourcy Wheeler, of Dublin, Ireland.

At the annual Convocation of the College on Friday evening the 1932 class of candidates for Fellowship in the College will be received. Dr. J. Bentley Squier, of New York, will deliver the annual address, and Robert A. Millikan, director of the Norman Bridge Laboratory of Physics of the California Institute of Technology, will deliver the Fellowship address.

The annual fracture oration will be delivered by Dr. Philip D. Wilson, of Harvard Medical School and the Massachusetts General Hospital, Boston.

Programs for meetings on Tuesday and Thursday evenings in the ballroom of the Statler Hotel at which a number of outstanding American ophthalmologists and otolaryngologists will present papers of interest to those who practice those specialties are being prepared and will be published in an early issue.

FEATURES OF THE PROGRAM

A symposium on cancer and a conference devoted to the consideration of the essentials in the organization and administration of cancer clinics, under the auspices of the Committee on the Treatment of Malignant Diseases, are features of the program at headquarters on Thursday.

A conference on traumatic surgery, under the auspices of the Board on Industrial Medicine and

Traumatic Surgery is being arranged for Friday with a program which will include presentations by leaders in industry as well as surgeons and hospital administrators.

The newest surgical films both sound and silent will be shown daily in the ballroom of the Statler Hotel. An extensive program of film contributions will be presented.

HOSPITAL CONFERENCE

An interesting program of papers, round table conferences and practical demonstrations dealing with many of the problems related to the hospital standardization program of the College and hospital efficiency in general is being prepared for the annual hospital conference which opens at 10 o'clock on Monday morning in the ballroom of the Jefferson Hotel. The conference continues Monday afternoon and on Tuesday and Wednesday both morning and afternoon. The program for this conference is planned to interest surgeons, hospital trustees, executives and nurses and an invitation to attend is extended to all persons interested in the hospital field.

HEADQUARTERS

General headquarters for the Clinical Congress will be established at the Jefferson Hotel, 12th and Locust streets, where the ballroom, Crystal and lobby rooms and foyers adjacent thereto on the mezzanine and second floors have been reserved for the exclusive use of the Congress for scientific meetings, conferences, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc. The ballroom of the Statler Hotel at Washington and 9th streets will be utilized daily for films, exhibitions and certain scientific sessions.

ADVANCE REGISTRATION

Attendance at the St. Louis session will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. It will be necessary therefore for those who wish to attend the Clinical Congress in St. Louis to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special tickets which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding as the number of tickets issued for any clinic will

be limited to the capacity of the room in which that clinic will be given.

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

REDUCED RAILWAY FARES

The railroads of the United States and Canada have authorized reduced fares on account of the St. Louis session of the Clinical Congress so that the total fare for the round trip will be one and one-half the ordinary first class one-way fare. To take advantage of the reduced rates it is necessary to pay the full one-way fare to St. Louis, procuring from the ticket agent when purchasing ticket a confirmation certificate, which certificate is to be deposited at headquarters for the signature of the general manager of the Clinical Congress and the use of a special agent of the railroads. Upon presentation of a valid certificate to the ticket agent in St. Louis not later than October 25, a ticket for the return journey by the same route as traveled to St. Louis may be purchased at one-half the one-way fare.

In the eastern, central and southern states and eastern provinces of Canada, tickets may be purchased between October 14 and 21 on other sections of the United States and Canada at earlier dates. The return journey must be completed within thirty days from date of sale of ticket to St. Louis.

The reduction in fares does not apply to Pullman fares nor to extra fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stopovers on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to St. Louis and it is essential that a confirmation certificate be obtained from the agent from whom the ticket is purchased. These certificates are to be issued by the general manager of the Clinical Congress and issued by a special railroad agent at Clinical Congress headquarters on or before October 21. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified.

fied It is important to note that the return trip must be made by the same route as that used in going to St. Louis and that the certificate must be deposited at headquarters during the meeting and return ticket purchased not later than October 25

An exception to the above arrangement is to be noted in the case of persons traveling from points in certain far western states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including October 15 with a final return limit of October 31. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to St. Louis by way of a direct route and returning by way of another direct route with liberal stop-over privileges

COMMITTEE ON ARRANGEMENTS

Evarts A. Graham, Chairman

F. A. Jostes, Secretary

Executive Committee

Fred Bailey	Roland Hill
M. B. Clopton	F. A. Jostes
William T. Coughlin	W. C. G. Kirchner
L. W. Dean	H. G. Mudd
Ellis Fischel	Max Myer
Evarts A. Graham	

Willard Bartlett	Harvey S. McKay
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W. C. Gibson	Louis Rassieur
William P. Glennon	Francis Reder
Max Goldstein	William E. Sauer
John Green	Otto Schwarz
H. A. Hanser	Alphonse M. Schwitalla
Harvey Howard	M. G. Seelig
Walter Jones	Omar R. Sevin
R. Emmet Kane	Carroll Smith
W. E. Leighton	Max Starkloff
Curtis H. Lohr	Ross Woolsey
William H. Luedde	O. B. Ziemert
McKim Marriott	

PRELIMINARY PROGRAM FOR EVENING MEETINGS

BALLROOM JEFFERSON HOTEL

Friday Night—Monday Morning

Address of Welcome EVARTS & GRAHAM M.D. St. Louis Chamberman Committee on Arrangement

Introduction of Foreign Guests

Address of Retiring President International Congress on Surgery ALLEN B. KANAVEL M.D. Chicago

Inaugural Address J. BENTLEY SQUIER M.D. New York

The John B. Murphy Oration in Surgery SIR WILLIAM J. DE COURCY WHEELER M.S. F.R.C.S.I. Dublin Ireland

Tuesday Wednesday and Thursday Evenings

Symposium on Surgery of the Large Bowel

Diverticulitis of the Large Bowel VERNON C. DAVIS M.D. Chicago

The Hopeful Prognosis of Carcinoma of the Colon FRED W. RANKIN M.D. Rochester, Minn.

Gynecological Symposium

The Results of Irradiation in the Treatment of Functional Uterine Bleeding Based Upon a Study of Four Hundred Cases FLOYD E. KEENE M.D. Philadelphia

The Detection of Clinically Latent Cancer of the Cervix WILLIAM P. CRAIG M.D. Boston

Fracture of the Femur PHILIP D. WILSON M.D. Boston

Inflammation SIR GEORGE LENTHAL CHEATLE K.C.B. C.I.O. F.R.C.S. London England

Bronchiectasis and Its Treatment by Lobectomy in One Stage HAROLD BRANN M.D. San Francisco

A Discussion of Some Principles in the Pathology and Treatment of Empyema Thoracis JOSEPH A. DANNA M.D. New Orleans

An Experimental and Clinical Study of the Use of Radium in the Breast LOYAL DAVIS M.D. & MAX CUTLER M.D. Chicago

Some Observations on Appendicitis A Review of Four Thousand Appendectomies J. M. T. FINEY JR. M.D. Baltimore

Continued—Friday Evening

Introduction

Conferring of Fellowships

Conferring of Honorary Fellowships

Presidential Address J. BENTLEY SQUIER M.D. New York

Fellowship Address Some New Things in the History of the Prostate ROBERT A. MILLIKEN Ph.D. S.D. LL.D.

Director Norman Bridge Laboratory of Physics California Institute of Technology Pasadena

PRELIMINARY CLINICAL PROGRAM

GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY,
PROCTOLOGY, SURGICAL PATHOLOGY, ETC

WASHINGTON UNIVERSITY

BARNES HOSPITAL

EWARTS A GRAHAM, M B CLOPTON, A O FISHER, G H
COPPER, W H COLE, Dr ALLEN, W R RAINEY,
I Y OLCH, R ELMAN and P HEINBECKER—9, daily
General surgical operations
ERNST SACHS and ROLAND M KLEMM—9, daily Neuro-
logical surgery
JOHN R CAULK, D K ROSE, J H SANFORD, OTTO J
WILHELM and V R DEAKIN—9, daily Genito-
urinary surgery
VILRAY P BLAIR, J B BROWN and W G HAMM—9, daily
Oral and plastic surgery
J A KEY, ARCHER O'REILLY, J W STEWART, T P
BROOKES and F A JOSTES—9, daily Orthopedic
operations
H S CROSSEN, OTTO SCHWARZ, F J TAUSSIG, Q U
NEWELL, C D O'KEEFE and ROBERT CROSSEN—9,
daily Gynecological operations
Medical and surgical staffs—9 and 2, daily Clinical
demonstrations

ST LOUIS MATERNITY HOSPITAL

O H SCHWARZ, G D ROYSTON, F P MCNALLEY, T K
BROWN and R PADDOCK—9, daily Obstetrical
operations
H S CROSSEN, OTTO H SCHWARZ, G D ROYSTON, Q U
NEWELL, F P MCNALLEY, O S KREBS, C D
O'KEEFE, T K BROWN, C R WEGNER, R PADDOCK,
R J CROSSEN, M A ROBLEE and J E HOBBS—2,
daily Demonstration of obstetrical and gynecological
cases and specimens

ST LOUIS CHILDREN'S HOSPITAL

W M MARRIOTT, J V COOKE, A F HARTMAN, T C
HEMPELMANN and HUGH McCULLOCH—2, daily
Clinical demonstrations

MALLINCKRODT RADIOLOGICAL INSTITUTE

SHERWOOD MOORE, J W LARIMORE, O C ZINE, M G
SEIBEL and Dr WILSON—9 and 2, daily Clinical
demonstrations

ST LOUIS COUNTY HOSPITAL

Tuesday

F A JOSTES—9 Orthopedic clinic

Wednesday

E L DORSETT—9 Gynecology

Thursday

W E LEIGHTON—9 General surgery

Friday

F L DAVIS—9 Genito-urinary surgery

U S VETERANS' HOSPITAL

Tuesday

S L FILKINS, P H FINOT and J E WHEELER—9 Gen-
eral surgical operations

ST LOUIS UNIVERSITY

ST MARY'S HOSPITAL

Tuesday

WILLIAM T COUGHLIN—9 Brain tumor, carcinoma of
the breast.

JOHN STEWART—9 Stomach and duodenal ulcer

W W GRAVES and LEROY SANTE—9 Brain tumor and
duodenal ulcer

PHIL HOFFMAN, FRANKLIN ALBRECHT and CARL VOHS—2
Orthopedic clinic

Wednesday

GEORGE GELLHORN and WILLIAM KERWIN—9 Gyneco-
logical operations, prolapse of uterus, carcinoma of
uterus, Cesarean section

LEROY SANTE—9 The X-ray in gynecology

WILLIAM D COLLIER—9 Demonstration of gynecological
specimens

Thursday

WILLIAM E LEIGHTON—9 Cancer of the neck

LOUIS RASSIEUR—9 Gall-bladder operations

RALPH KINSELLA and WILLIAM D COLLIER—9 Demonstra-
tion of gall bladder cases

C E BURFORD and JOSEPH GLEN—2 Nephropexy

Friday

CARROLL SMITH—9 Goiter operation

CHARLES SHERWIN—9 Carcinoma of the breast.

RALPH A KINSELLA and WILLIAM D COLLIER—9 Goiter
cases

H H KRAMOWSKY and GEORGE H KOENIG—2 General
surgical operations and demonstration of cases

ST JOHN'S HOSPITAL

Monday

Staff—2 Dry clinic, bone cases A W HAM Bone
development. A E HORWITZ and C LINDEMAN
Parles disease LEO WILL Fractures JOSEPH
PEDEEN X-ray demonstration of bone cases

W H VOGT and associates—2 Obstetrical clinic.

Tuesday

B LEWIS, G CARROLL, LEO BARTELS, C D PICKRELL,
G H KOENIG, J M SCHATTYN and ROBERT F
HICKEN—9 Urological operations

O P J FALK and ANTHONY BRENNAN—9 Discussion of
diagnostic and medical aspects of urological cases

Staff—2 Dry clinic, diseases of the lungs J L MARDER
Carcinoma of lungs B MCMAHON Abscess of lungs
A MCMAHON Heart and lungs in surgical cases
GEORGE GAFNEY Empyema

Wednesday

L M RIORDAN, PERCY H SWAHLEN, WILLIAM VOGT and
M WEIS—9 Gynecological operations

Staff—9 General surgical operations WILLIAM P GLEN-
NON Gall-bladder surgery J MCMALE DEAN
Stomach and intestinal operations I H BOELER
Abdominal surgery G T GAFNEY Carcinoma of the
breast. W T COUGHLIN Brain surgery A. Mc-
MAHON and J J HAMMOND Discussion of diagnostic
and medical aspects of these cases

C H NEILSON A P Mc SCH J McH DEAN A
McMAHO O FALA and I H BOEMER—s Border
lin medical and u g cal cases
C H NEILS F KRAM J McFADDE W P GLF
NON J McH Dr N d DE A LE —s Sympo m
o go t

Th d y

B LAY s—g U log al op ti s
W VCGT—g Gy ec logical p ti
J McH DEAN—g Stoma h d int tinal operation
W P GLF ov—g Gout p tiom.
W K McINTIRE—g Rectal ope ti
L H BOWDEN—g D trati n f resth m th
d and pp t
A P MOUN CH and H G BRI ROW—g Discussio i
d g o tic and d cal aspects of tl sc cases
Staff— Dry clinic J P C STELLO D gno s fac te
abd minal to duno in hild t R H LAD Tausma
t c s ry J McFADDE. Neur log l feets f
tr m tic surgery W GALLAGHER T eaton nt f
iucose ul e
O J F A s J HAMMOND and WILLIAM GALLA ER—
Sympos m g d bladder disea s R HULAN
fh ac t s rgic i bd men.

F day

F H S AHLEN nd K J RINGO—g Gyn col g cal
op io
WILLIAM G LL HER—g Abd minal ope ti ns.
T R KEN EDY—g Gen l ry
FRED BAILEY—g Abd minal s g ry
A J BARNED VCK d R F BARNY—g Doc ss o f
di ost c d medical j ts f these cases
J WER KEN—E doc in d t b
J A HARLO d WILLIAM VOOR—E p t g lau
A E HORWI —O thoped g ry

FRIDAY

T eday

E A DOS —g Ov n n ext acts
E L SHRAD —g s The hu d ana ext act in
os jiao
A A WER —g s The effect l th lin castrat
J B M CHELL —g s Th ctu of thecln d thecl i
foni
G O BR — The lin d o ana e t ts
pdep y
W D COLLIS —g s Th effect f the li th g nial
t t f th f male whut t

Wed day

ALBE T KUNT —g A to m m r j i m m la
u to g ry
h CHRISTIAN —g s Th t n m o yst m
d spec al se se
A W HAN —g 45 Cal um m taboli m m bo d
bo d j pm t
R A KINSELLA —g s Bacterial doca d tis

Th day

A H HERTZMAN and F E FRAI KE—g D m t ti
and disc ssa f ce bal c ulat
JOHN AUER—g 4 St d o the co tractio of fibna
and fibnoid substa ce
A P B ICGS —g s I tw s pects f n phntes
W H GR TH—g 35 Food o stit tio m l t to
food umpti n (app tit)

F day

ALBERT KUNT—g Stru t l changes in the stom.
g gna and g nlio cells associated with stan
diseases
PBI IP KATIMA —g s Anten r p linary h m m
U S FLEI HER d L R JOH —g s Stum kness
abdit
G O BRUGH and H L LAN E—i St dies a pe
lous anem

ST ANTH S HO PIT L

F day

W G YLER—g C ecological clinic
F H R N—g H te act my
J E F REIS— (all bl dd s s r)
KUB W SMITH—g H n a p to
H d n da
A A SCHNEIDE —g H m m op tio s
NEIL MOORE d E SEXTO —g D seases f th kidn ya
W L LIO G—g s Plastic rgery
W J PULLIAM—g 30 Appendectomy

Th day

H S McHAY J C LYTER D COLLIER M J P LLIAM
R M S B ASSETT and P N UN—g Stom ch and
gall bladd puratio coes d ti f medical and
p th f cal aspects chanc of onst elics

F day

H S ICK M J PULLIAM R M S B ASSETT and P
NEUN—g General s rg cal uni d m m t ti
s th l g cal p cum lantern and

W L R S RO SA r STM

F day

Symposium n Medical and S gical Aspe t
of Pulm nary T berc l s

C L B STURTELL—g Diag onst of pulm ry t b r
c) s
E H KE YLER—g 20 Roentgen find g in p lmo ary
t b cul s
ALP V R McMAN —g 20 D f t l daga
toxi thyr d d pulmonary t b lous
A HEV KE—g 30 Pu um th m j l m ry t r
culous
C W EHLER—g s Ol tho xingulum nary t b r
lous
J L MUDD—g s S g cal treatm t f pulmo ary
t bercul s

Wed day

J L MUDD—g Tho acopl ty bd phr n ect my

Th day

J L MUDD—g Th racoplasy nd phr n ecto)
J L MUDD—g s Exh u ti f pot p e ti p t ts

F day

J L MUDD d C W BELLER—g Demonstr tio f
p m th leoth ax a d ph nect my s

FRISCO EMPLOYEES HOSPITAL

Th day

R A WOOLSE —g Bsc m j es d back d t

F day

R A WOOLSE —g General surgical operati

JEWISH HOSPITAL

Tuesday

- ELLIS FISCHER, ERNST JONAS and J PROBSTEN—9 General surgery
 SAMUEL NEWMAN—9 Rectal surgery
 H. EHRENFEST, F J TAUSSIG, S A WEINTRAUB, GROVER LIESE, S F ABRAMS and Dr PATTON—2 Obstetrical clinic
 Drs GREY and SOMOGYI—2 Demonstration and discussion of experimental work of surgical significance

Wednesday

- R M KLEMM—9 Neurosurgical clinic
 H EHRENFEST, F J TAUSSIG, S A WEINTRAUB, GROVER LIESE, S F ABRAMS and Dr PATTON—9 Gynecological operations
 Drs SINGER, SIMON and FRANK—2 Medical and surgical thoracic clinic with demonstration of unusual X-ray films

Thursday

- MAX W MYER, HARRY SANDPERL, E V M MASTIN and E K DIXON—9 General surgery
 B MAY, D K ROSE and McCCLURE YOUNG—9 Genito-urinary surgery
 MEDICAL STAFF—2 Pre operative medical care of patients
 PAUL LOWENSTEIN—3 Technique of injection of varicose veins

Friday

- ELLIS FISCHER, WILLARD BARTLETT and PAUL LOWENSTEIN—9 General surgery
 F H ALBRECHT, FRED JOSTES and J A KEY—9 Orthopedic surgery
 S GREY—2 Pathological demonstration
 P C SCHNOEBELE—3 X-ray demonstration of gastrointestinal lesions
 B MAY, D K ROSE and McCCLURE YOUNG—2 Urological dry clinic

ST LOUIS CITY HOSPITAL

Monday

- W H VOGT, PERCY H SWAHLEN, T R AYARS and W J HANS—2 Obstetrical clinic

Tuesday

- MAX MYER, CHARLES F SHERWIN and HENRY HASSETT—9 General surgery
 W J DOYLE and J J LINK—9 General surgery
 ROLAND HILL, FRANCIS REDER and THOMAS S WIMBER—9 Industrial and traumatic surgery, dry clinic
 GRAYSON CARROLL, GEORGE H KOENIG and CLARENCE MARTIN—2 Genito-urinary clinic

Wednesday

- EMMETT RUND, WILLIAM STUDE and S A WEINTRAUB—9 Gynecological clinic
 H H HELBIG, C W GAERTNER, A V MARQUARDT and W H CLITHERO—9 Gynecological clinic
 JOHN W STEWART, CHARLES F SHERWIN, CHARLES WOLFF, A E HORWITZ and E L MORSE—9 Fracture clinic

Thursday

- JOHN W STEWART and J L FERRIS—9 General surgery
 FRANCIS REDER, J W THOMPSON and ROLAND S KIEFFER—9 General surgery

- FRANK J TAINTER, WALTER C G KIRCHNER and W J DOYLE—9 Penetrating wounds of the chest and abdomen, dry clinic
 H H KRAMOLOWSKY and BENJAMIN F MAY—2 Genito-urinary clinic
 H G LUND and P N DAVIS—2 Genito-urinary clinic

Friday

- FRANK J TAINTER and W J GALLAGHER—9 General surgery
 ROLAND HILL, THOMAS S WIMBER and N M FREUND—9 General surgery
 MAX MYER and LEROY SANTE—9 Surgical and radiological treatment of cancer

BARNARD FREE SKIN AND CANCER HOSPITAL

Tuesday

- FRED J TAUSSIG, S S LEVIN, E S AUER and FRED EMMERT—9 Surgery and radium therapy in cancer of the uterus and vulva
 FRED J TAUSSIG, GEORGE GELLHORN, S S LEVIN, E S AUER, FRED EMMERT, KATE SPAIN and MARION WACHOWIAK—2 Malignancy index in gynecological cancer, technique of vulvar operations, exhibition of specimens

Wednesday

- ELLIS FISCHER, CHARLES F SHERWIN and GEORGE GAFNEY—9 Radical surgery and interstitial radium therapy
 D P BARR, C M STROUD and E C ERNST—2 Internal medicine and radiography in relation to cancer

Thursday

- GEORGE GELLHORN, S S LEVIN, E S AUER, FRED EMMERT, KATE SPAIN and MARION WACHOWIAK—9 Surgery and radium therapy in cancer of the uterus
 M G SEELIG, L H JORSTAD and E C ERNST—2 Demonstration of the production of tar cancer, pathological specimens, X-rays and photomicrographs of unusual problems in malignancy, specimens of crown gall in plants produced by bacillus tumefaciens, studies of mitochondria in cancer, reticulum in cancer growth

Friday

- W E LEIGHTON, GRAYSON CARROLL, THOMAS M MARTIN and J C LANDREE—9 Surgical cancer therapy
 M F ENGMAN, RICHARD WEISS, A H CONRAD, C V LANE and M F ENGMAN, JR—2 Amebic and phagedenic ulcers and ulcers of unknown cause, presentation of cases, lantern slides

SHRINERS' HOSPITAL

Tuesday

- Staff—9 Orthopedic operations
 Staff—2 Orthopedic clinic.

Wednesday

- Staff—10 Orthopedic end results.
 Staff—2 Orthopedic end results

Thursday

- Staff—9 Orthopedic operations
 Staff—2 Orthopedic end results.

Friday

- Staff—10 Orthopedic end results

MISSOURI BAPTIST HOSPITAL

Monday

C H SHUTT— G al g ry
J S YOUNG— Rad l y
M L KLEFF— D m tr t f p th l
f t u es
G R IES—3 Cyt l g st dy fca c
R M KLEMM—3 N g ry

Tuesday

E L D— Gyn l g al p t
M L KLEFF— B and l t g ry
J E GLENN— G to— na ry urg y
H T OTT— G al g ry
W B A LITT and W B R LITT J— G o l g ry
R J C O— Gyn l g y
D K R O— Genito— na ry ch
G E IES— Demo tr t f m thod f blood
tr f n
W E WER—3 Got t l g y

Wednesday

C H SHUTT— Gen l gery
M L KLEFF— B and l int g ry
C E BURG— G auto na ry
J B BR WN— Pl t g ry
W B R LITT J W BARTLETT J— d J C LYTER—
G al w ry
R K A DRE S O H C MFBELL C E G LILA
L R HEMP EMAN S D GRAM— d J C LYT—
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C E BURG— G auto na ry g ry

Thursday

R S K— G l g ry
M L KLEFF— B and l int gery
W S WITT— G l g ry
D K R— G auto na ry g ry
W B— and W B R LITT J— G o l g ry
S I SCHW— and W BARTLETT— Psych na asp t
l urg y
S B GRAY— Th h rting l case
J P ATLEE— Genito— na ry g ry
J B B OVN— f d tral g ry
J P MURPHY—3 Th l ryna l g te case
J S Y V O—3 Phy th rapy

Friday

M L KLEFF— B and l int g ry
H M MOORE— G l urg ry
Q U N WEL— Gyn col g al p t
R M KLEMM— G al perati
W BARTLETT J— G l g ry
W L C KRAD and H F D O— D cal g ry
E L DORSETT— Gyn l g y
W BARTLETT JR—3 Ched sal tyfact g t g ry

ST LUKE'S HOSPITAL

Tuesday

J H SANF RD J H R CA— OTT W KREMER J H
P TIO and C E B R F RD— G m t l g ry
g ry
D SROT MA— G to— urinary lms
J H SA TORD— Diagn sis and t eam t f l d n y
l ns
O C ZINK— Y y t r p t l t a
R M KLEMM—3 B m bsc

Wednesday

C D OKE RE OTTO KREB R ERT C ss d
E C SCHM— Gynecol gical pe t t na
J V GH and GARY JOWER— Ob tetrical nd gyn
col gical clinic
C D OKE— O ana cy t
OTT KREB—3 St lity

Thursday

R M K MM— N l g u l g ry
A ORE L— d J E SR AR— Orth peduc rg ry
J E S—3 Orth p d clin
J E S WA—3 F ct f ppe thurd fl m
O C ZINK—3 ray d m t d io

Friday

O R S R— G al g ry
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LUTHERAN HOSPITAL

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H N GRAC—3 S gical sud t f tru t f
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slides

Tuesday

J L H RY— G eral urgical p t
J L HUTT— Co genital me lo (Hirsch pro g
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Wednesday

R E SCH TER— Gen al g al p rations
H A HA— and T H HA— General su gcal
p t with p nal anesthesia
H A HA ER— d T H HA s— Embolectomy
dem tr t f ses
E W S—3 R entgen l gical diagnosis f po ta
eo and l m m p t m

Thursday

J L HUTT N— Gen al gical pe t t ns

Friday

H A HA— and T H HA s— Gen al gical
perati
R E SCHLUTER— Gen al gical pe t t

U S MARINE HOSPITAL

Monday

J E SMITH— Ched al demo tr t f bsc as fl s

Tuesday

W M J— G al urgical p t t
W L CORE— Clinical d m nstr t f bd mual
t m with b tr u f tran rsc col

Wednesday

W M J— G al gical p t t ns
J T DELO— Clin al d m trat f p l nc
b tr u f stomach

Thursday

W M J— Gen al gical p t t ns

DEACONESS HOSPITAL

Monday

HERMAN NEIDERT, FRANCIS REDER, FRED BAILEY, JOHN C MORFIT, ROBERT E SCHLUETER and A R SHREFFLER—2 Medico-surgical dry clinics

Tuesday

FRED W BAILEY, WILLIAM H NORTON, A V MARQUARDT, LEO A WILL and J EDGAR STEWART—9 General surgery and orthopedic operations
A R SHREFFLER, EDWIN SCHISLER, M L KLINEFELTER, GUY SIMPSON and N C GAYLOR—2 Medico-surgical clinical demonstrations

Thursday

L LEE DORSETT, N C GAYLOR, JOHN W STEWART, FRED W BAILEY, FRANCIS REDER and HERMAN NEIDERT—9 General surgery and neurological operations
L H HEMPLEMAN, LEO BROOKS, CLAUDE PICKRELL, CHARLES A STONE, JOHN C MORFIT, M F ARBUCKLE and FRED C SIMON—2 Clinical demonstrations

MISSOURI PACIFIC HOSPITAL

Tuesday

O B ZEINERT and associates—9 General surgical operations
W P ELMER and associates—9 Medical diagnostic clinic

Wednesday

I H BOEMER and associates—9 Abdominal surgery
W K MUELLER and associates—9 Roentgenological clinic
H J SCHERCK and associates—9 Genito-urinary surgery

Thursday

A O FISHER and associates—9 General surgical operations
W P ELMER and associates—9 Medical diagnostic clinic

Friday

O B ZEINERT and associates—9 General surgical operations
W K MUELLER and associates—9 Roentgenological clinic
J H SANFORD and associates—9 Genito urinary surgery

SURGERY OF THE EYE, EAR, NOSE, AND THROAT

WASHINGTON UNIVERSITY

BARNES HOSPITAL

Monday

FREDERICK O SCHWARTZ—2 Eye operations

Tuesday

M F ARBUCKLE and A W PROETZ—11 Otolaryngological operations
MEYER WIENER—2 Eye operations

Wednesday

HARVEY J HOWARD—2 Eye operations

Thursday

LAWRENCE T POST—2 Eye operations

Friday

A J CONE, B J McMAHON and WILLIAM L HANSON—9 Otolaryngological operations
J B COSTEN, L J BIRNBER and F K HANSEL—11 Otolaryngological operations
H ROMMEL HILDRETH—2 Plastic surgery of the eye

McMILLAN HOSPITAL

Staff—Daily, 9 00 and 10 30 Laboratory demonstrations
LAWRENCE T POST Slit lamp demonstration
WILLIAM E SHAHAN Physiological apparatus (including thermophore)
WILLIAM F HARDY Ocular muscles
H ROMMEL HILDRETH Ultraviolet light therapy
B Y ALVIS Cylinder skiascopy
M HAYWARD POST Advanced refraction technique
FREDERICK E WOODRUFF Ophthalmoscopy
MAX W JACOBS Ocular changes during pregnancy
J E JENNINGS Color vision tests
ROY E MASON Industrial ophthalmology

Monday

HOWARD C KNAPP—2 Ocular tuberculosis clinic
MEYER WIENER—2 Diagnostic eye clinic
WILLIAM M JAMES—3 Ocular syphilis clinic

Tuesday

M HAYWARD POST—2 Diagnostic eye clinic

Wednesday

HOWARD C KNAPP—2 Ocular tuberculosis clinic
WILLIAM E SHAHAN—2 Diagnostic eye clinic
WILLIAM M JAMES—3 Ocular syphilis clinic

Thursday

WILLIAM F HARDY—2 Diagnostic eye clinic

Friday

HOWARD C KNAPP—2 Ocular tuberculosis clinic
LAWRENCE T POST—2 Diagnostic eye clinic
WILLIAM M JAMES—3 Ocular syphilis clinic

OSCAR JOHNSON INSTITUTE

Staff—Daily, 9 00 and 10 30 Laboratory demonstrations
HARVEY D LAMB Pathology of the eye
WILLIAM M JAMES Conjunctival cytology
H ROMMEL HILDRETH Surgical anatomy of the eye and orbit
GEORGE H BISHOP and B HOWARD BARTLEY Physiology of the eye
PERCY W COBB Physiological optics
CHARLOTTE WEIGHARD Chemistry relating to ophthalmology
ROSALENE A HETLER Nutrition relating to ophthalmology
LOUIS A JULIANELLE, CHARLES WEISS and MARION C MORRIS Bacteriology of the eye
R WENDELL HARRISON Tissue culture of the eye
Staff—Daily, 2 00 Laboratory demonstrations
GEORGE E HOLMAN, LOUIS J BIRNBER, JAMES B COSTEN, HARRY N GLICK, I D KELLEY, JR and DOROTHY WOLFF Anatomy of the eye

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S M DEA Cyl 1st 3
A J CON T mperat r h g
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ST LOUIS UNIVERSITY

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ALEXIAN BROTHERS HOSPITAL

Monday

J M KELLER—3 Ophthalmological clinic

Tuesday

D P FERRIS—2 Otolaryngological clinic

Wednesday

J M KELLER—3 Ophthalmological clinic

Thursday

D P FERRIS—2 Otolaryngological clinic

ST LOUIS COUNTY HOSPITAL

Monday

O W KOCH, J B COSTEN and A M ALDEN—2 Otolaryngological operations

Wednesday

C P DYER, WILLIAM F HARDY and JOHN McGRATH—2 Ophthalmological operations and demonstration of cases

Friday

JOHN GREEN and CARL BEISBARTH—2 Ophthalmological operations

ST LOUIS CITY HOSPITAL

*Tuesday*CARL EBER—2 Ophthalmological operations
E LEE MYER—2 Otolaryngological operations*Friday*

E LEE MYER—2 Otolaryngological operations

MISSOURI BAPTIST HOSPITAL

*Monday*R J PAYNE—2 Otolaryngological operations
H N GLICK—2 Otolaryngological operations*Wednesday*R J PAYNE—2 Otolaryngological operations
H N GLICK—2 Otolaryngological operations
J F HARDESTY—2 Ophthalmological operations

DEACONESS HOSPITAL

*Monday*V V WOOD—2 Otolaryngological clinic
F C SIMON—2 Otolaryngological operations.*Wednesday*V V WOOD—2 Otolaryngological clinic
F C SIMON—2 Otolaryngological operations

DEPAUL HOSPITAL

Tuesday

V V WOOD—2 Otolaryngological operations

JEWISH HOSPITAL

*Monday*EUGENE T SENSENEY—2 Radical mastoidectomy
I D KELLEY, JR—2 Direct vision adenectomy
A M ALDEN—2 Classic closure of mastoid fistula*Tuesday*

MAX W JACOBS and B Y ALVIS—2 Ophthalmological clinic, operations and demonstration of cases

*Wednesday*E LEE MYERS and staff—2 Demonstration of bronchoscopy cases, laryngectomy
C E EMER—2 Direct laryngoscopy examination (Haslinger)
I D KELLEY, JR—2 Larynx suspension
M D PELZ, O R DOBBS and MAXWELL FINEBERG—2 Diagnostic clinic with demonstration of cases*Thursday*

MEYER WIENER—2 Ophthalmological operations

*Friday*LOUIS K GUGGENHEIM—2 Demonstration of cases
A M ALDEN—2 Snare and guillotine tonsillectomy and demonstration of ligation of bleeder, dacryorhinostomy
S B WESTLAKE—2 Radical mastoidectomy

LUTHERAN HOSPITAL

Tuesday

I C SIMON—2 Otolaryngological operations

Thursday

F C SIMON—2 Otolaryngological operations

MISSOURI PACIFIC HOSPITAL

Tuesday

S B WESTLAKE—2 Otolaryngological clinic

Wednesday

E P NORRIS and VINCENT JONES—2 Ophthalmology, diagnostic and operative clinic

ST LUKE'S HOSPITAL

Monday

W E SHAHAN—2 Ophthalmological operations

Tuesday

B J McMAHON—2 Otolaryngological operations

Thursday

B J McMAHON—2 Otolaryngological diagnostic clinic

FRISCO EMPLOYEES' HOSPITAL

Tuesday

RICHARD J PAYNE—2 Pulmonary lavage

Wednesday

J ELLIS JENNINGS—3 Tests for color blindness

W F W N and P R N MO RS Phys i gy f th

C TH RINE BURNF TER Ch m try f th

E E N D XON B te l gy f th

S M DEAN Cytol gy

A J C E T mpe t ch g

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W LEAK SM — 3 Ot l ryng l gical chui.

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